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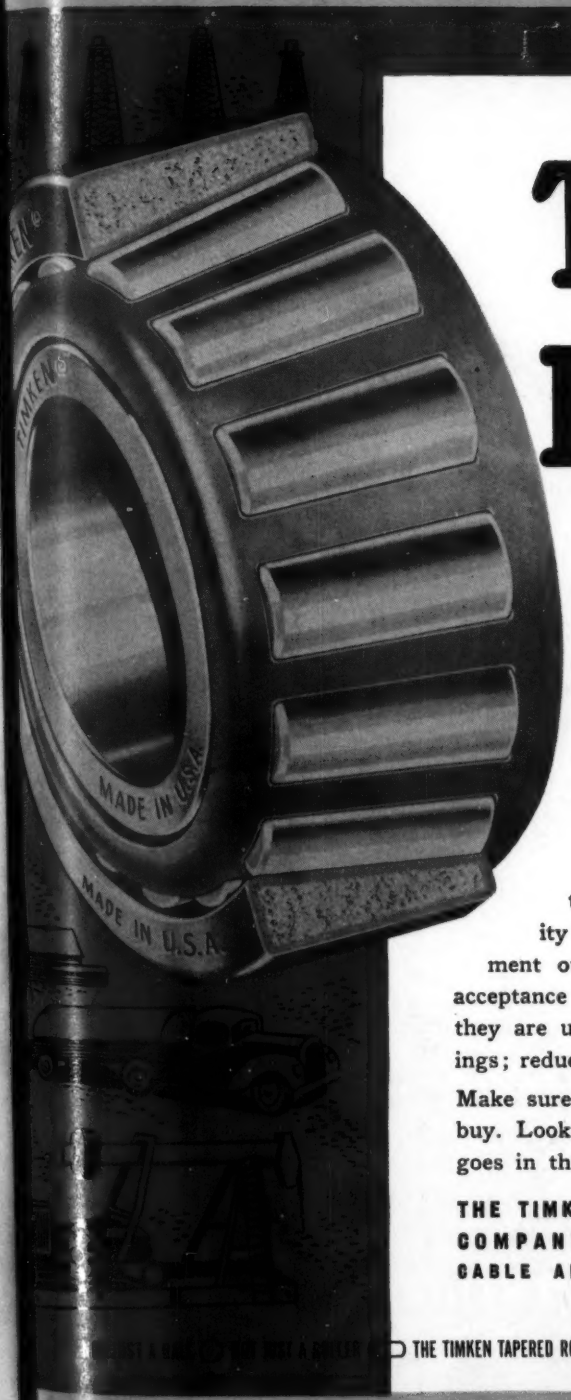

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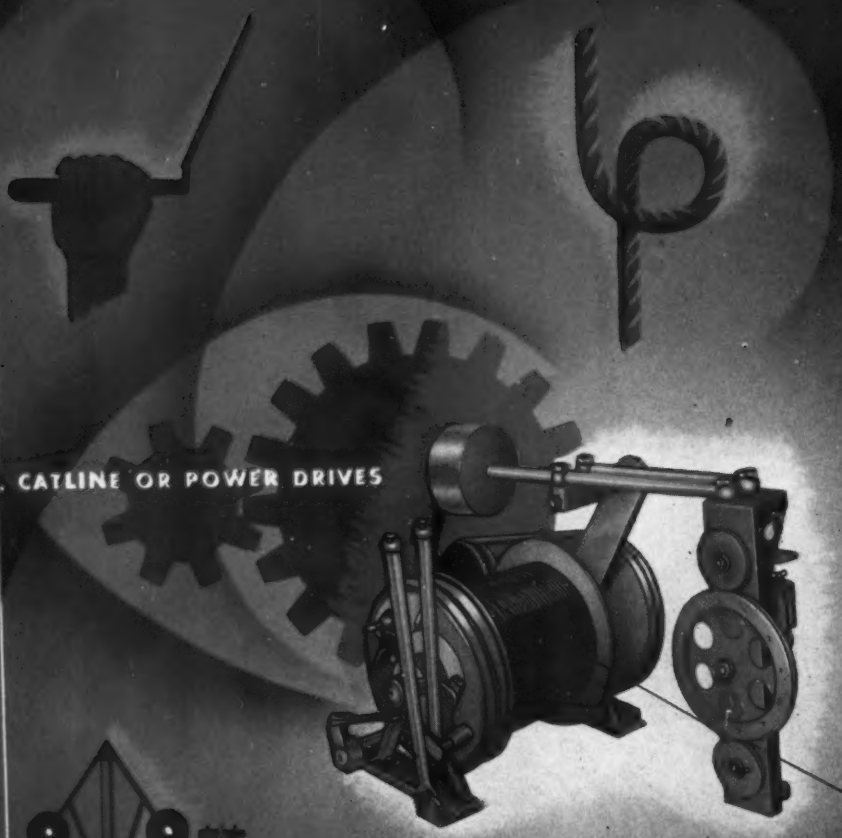

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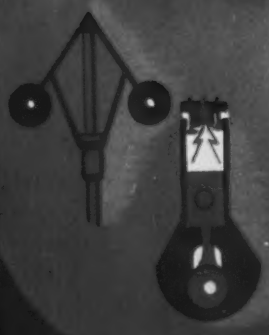

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TCC UNIT CHARGES 8 DIFFERENT STOCKS ON 8 SUCCESSIVE DAYS!

The remarkable flexibility of the TCC process is well illustrated by the following record from the daily log sheets of a TCC plant:

Date	CHARGE TO TCC PLANT CONTAINED:			
	Full Crude	*Reduced Crude*	*Virgin Gas Oil*	*Kerosene*
1st day	—	—	100%	—
2nd day	—	—	75%	25%
3rd day	—	—	—	100%
4th day	25%	50%	25%	—
5th day	70%	—	30%	—
6th day	50%	—	30%	20%
7th day	50%	30%	—	20%
8th day	50%	50%	—	—

Only a Houdry-licensed catalytic cracking unit could possibly accommodate such frequent changes of charge stock without shutdown and consequent considerable (and costly) loss of production. In the case of the TCC unit reported above, no major reduction in throughput, or in output of catalytic gasoline, resulted from the daily and drastic variations in feed charge.

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Economic Incentive

LAST week General Motors' Sloan saw fit to devote the first four pages of his annual report to more than 400,000 stockholders to a discussion of the importance of economic incentive. The veteran head of an organization which for several years had led all manufacturers in output of oil-consuming products is concerned about trends in our economic life.

The statement opens with a note: "There never was a time since the beginning of this country when the concept upon which it was founded—economic, social, and political freedom—stood in the balance to the degree it does today. And what is true of America is true of the world at large. It is encouraging that this fact is now recognized. It is discouraging that there exists so great a lack of understanding of what must be done to preserve and strengthen this concept in a fundamental way."

As has been emphasized by leaders of the oil business in recent months, Sloan points out that too many people think of a free economy as something of significance only to business. Actually, all the freedoms are interrelated and are at stake in the present crisis.

The automotive head says the responsibility of business is to establish a sound foundation for high employment and expanding production. At present these are being maintained because of shortages in goods brought about by the war, with expansion financed largely by accumulated savings.

Sloan maintains that the present excessive taxes are the major threat to a sustained strong economy and proves his point by showing that what is left after taxes is not sufficient to encourage venture capital, provide funds from within operations for reinvestment, and do all the things that have to be done to maintain an economy at the required level.

His remedy in brief is a maximum tax on business profits and other taxes of 50 per cent. "No one," he says, "should be required to contribute more than half his income to the maintenance of Government."

Every situation outlined in this analysis applies to the petroleum industry. The annual statements of the past few weeks reveal the tax situation. Tax collections and taxes charged against income of a typical integrated company are approximately equal to employes' pay and benefits and in most instances three or more times the dividends. A substantial part of what employes and stockholders obtain also goes to the tax collectors.

Wholly aside from its own activities, the petroleum industry, because of the general use of its products, has a direct interest in what the ending of economic incentive would mean to our way of life. Again quoting Sloan, "The final price may well be failure of the economy to meet its full responsibilities to society and with it a real danger to the existing system of free competitive enterprise and the American concept of individual freedom."

Industry Can Meet 4-5 Per Cent Demand Gain, A.P.I. Predicts

THE oil industry will be able to meet an increase of 4 to 5 per cent in demand during the coming summer-winter period, the American Petroleum Institute's National Oil Policy Committee was told this week.

In an official report, the subcommittee on short-term availability said the total supply of petroleum available to meet domestic consumption for the 12-month period which began April 1 will average 6,025,000 bbl. daily, an increase of about 8 per cent over the demand during the previous 12 months.

In making the report public April 19, however, William R. Boyd, Jr., A.P.I. president, said that even with the increase, "supply and demand promise to be in delicate balance."

Race to Be Close

"If conditions outside of its control do not retard the continued expansion of the oil industry," Boyd said, "all former records will be surpassed by quantities of gasoline and fuel oil produced during the coming 12-month period, and, if the public will practice reasonable restraint, deliveries will probably meet the increasing demands. However," he added, "the race to meet the enormous increase in consumption will be close."

The subcommittee, headed by H. W. Page, based its forecast on four assumptions:

That there will continue to be freedom from government interference or controls.

That there will be no major interference with the industry's expansion resulting from strikes or disasters.

That there will be no unusual delays or supply failures in the flow of materials for expansion programs.

That excess of imports over exports will be at the levels estimated by the Bureau of Mines as of March 25. (102,000 bbl. daily. *See The Oil and Gas Journal, April 8, page 51.)*

The subcommittee said that existing transportation facilities, plus new facilities to be completed during the period, would, if used to the maximum, be sufficient to transport the estimated available supply, although some of the present abnormal tank-car movements still would be required.

Spot Shortages Seen

The subcommittee report said that, based on previous experience, distribution problems may be expected to occur when demand reaches 95 or 96 per cent of maximum supply capacity.

"Even though a breakdown in supply was avoided during the past winter," it said, "the race between unprecedented demand and record-breaking supply was so close that some spot shortages were unavoidable. It was found impossible, in some instances, to have the right amount of the right product at the right place at exactly the time needed."

The same problems, it indicated, might be expected during the coming summer and winter months if demand continues to increase.

Forecasts of the subcommittee on domestic production and runs to stills may be found in the accompanying tables.

ESTIMATED DOMESTIC PRODUCTION—APRIL 1, 1948-MARCH 31, 1949
(Thousands of barrels daily)

	1948			1949	Average
	2nd Q.	3rd Q.	4th Q.	1st Q.	12 months
Crude oil	5,450	5,505	5,555	5,600	5,528
Natural gasoline, condensates, etc.	394	402	416	421	408
Total domestic supply	5,844	5,907	5,971	6,021	5,936
Actual total domestic supply previous year	5,383	5,549	5,707	5,736	5,594
Per cent increase	8.6	6.5	4.6	5.0	6.1

CRUDE RUNS TO STILLS
(Thousands of barrels daily)

	2nd Q.	3rd Q.	4th Q.	1st Q.	Average 12 months
Forecast (1948-49)	5,452	5,498	5,607	5,652	5,552
Actual runs, previous year	4,925	5,268	5,298	5,370	5,216
Per cent increase	10.7	4.4	5.8	5.3	6.4

Gasoline Supplies to Be Adequate, Knight Says

OVER-ALL supplies of gasoline "will be adequate to meet foreseeable demand" during the next 6 months "and at the same time permit accumulation of sizable stocks of distillate fuels for the coming heating season," E. T. Knight, petroleum economist of Atlantic Refining Co., declared April 19 at the spring meeting of the Empire State Petroleum Association in New York.

Spot shortages may occur in specific areas, Knight said, but they will be due primarily to "distribution problems which the industry will hasten to solve."

"The next 6 months will be a critical period in the gasoline economy," Knight predicted, but indicated that any spot shortages would disappear before the end of September.

"During the 6 months following September 30, a period when gasoline supplies must give way to the requirements for heating oils, it may be expected that consumers' demands for gasoline will be fully met and there will be an accumulation of stocks to levels that will meet the projected demand during the summer of 1949."

Total domestic demand for gasoline during 1948, Knight said, is expected to be 6.9 per cent greater than the indicated demand for 1947.

Survey Shows California Oil Wages Up $1.50 to $2

A recent survey taken by Oil Producers Agency of California of major, minor, and independent oil companies in the state shows that in each group prevailing wage rates for drilling and production employes have increased $1.50 to $2 per day over those of last year.

Most companies have abandoned the practice of paying cost-of-living bonuses, and have included the amount in basic wage rates, the survey revealed. In addition to the basic rate, all of the majors, most of the principal minors, and a few independents, pay a shift differential of 6 cents per hour for the midnight to 8 o'clock shift and 4 cents per hour for the afternoon shift from 4 p.m. to midnight.

The survey covers 33 oil-field job classifications of 8,333 workers on which 7 major, 37 principal minors, and 76 independent companies reported. Details of the survey have been reported by the agency to the participating companies.

Sun Offers $400,000 School Contribution

A contribution of $400,000 has been offered by Sun Oil Co. toward the building of a joint junior-senior high school for students in three lower Delaware County school districts in New Jersey.

The offer is contingent upon the success of the neighboring communities of Lower Chichester Township, Marcus Hook, and Upper Chichester Township to raise the remaining funds for the proposed $1,600,000 building by December 31, 1948.

Cost Reduction, New Techniques Feature Southwest A.P.I. Meeting

by George Weber

SAN ANTONIO. — New techniques and equipment designed to alleviate the mounting costs of drilling for and producing oil highlighted the spring meeting of the Southwest District of the American Petroleum Institute's Division of Production here April 14-16.

Balancing the technical discussions were addresses of a general nature, concerning the industry's public-relations program and problems of national and international concern. The 550 operators and engineers attending the 3-day meeting were reminded of the magnitude of the industry's responsibility in peace or war, and of the equally important advantages of operations under a system of free enterprise.

Committee meetings, which occupied the first day, were heavily attended. Four topical and three subcommittees met to review work and outline next year's studies. Cycling came up for further discussion by the committee on production technology, which hopes to bring out factual arguments both in favor of and in disagreement with that technique as applied generally to producing distillate-type reservoirs.

Gas Storage Discussed

A subcommittee will be named to study completions and recompletions in fields with thin oil sections. Mechanical and chemical aids in cementing operations were discussed, and the general subject of completion methods was assigned for study and report by regional groups within the district. Gas storage as a means of better balancing seasonal supply and demand, and as an aid in conserving current casinghead-gas production for future use, was presented as a subject for serious consideration.

Much of the discussion of the topical committee on drilling practice concerned the problems to be encountered in very deep drilling. Limiting factors, according to consensus at the meeting, appear to be present practices on the rig as well as physical limitations of equipment.

The need for more than one string of protective casing in some deep wells revived the subject of additional standard sizes for casing. It was pointed out that the need for setting several strings in some wells—to case off hazardous sections of open hole or protect oil sections— results in abnormally small holes at bottom. Representatives from all district chapters will be asked as a new committee to recommend a solution by next November.

Mud, considered by some as the most important factor contributing to successful deeper drilling, is a subject now referred to the subcommittee on drilling fluids, which is undertaking studies on a regional basis for future reports on both sodium and calcium-base muds.

A special project was launched by the topical committee on production practices, dealing in the study of all protective coatings on oil-field equipment, surface and subsurface. Further, that committee will participate in the pumping studies being conducted at Oklahoma City under A.P.I. auspices.

The opening session of the general meeting followed an address of welcome by Al Buchanan, prominent San Antonio drilling contractor, and chairman of the general arrangements committee for the spring meeting. An outline of the Institute's aims and accomplishments was given by Jake L. Hamon, Cox & Hamon, Dallas, who is vice president of the Production Division.

Artificial lift in the Permian basin of West Texas and New Mexico led off in the first technical session. Hydraulic pumping and gas lift neither a predominant method in that area, were, however, reported as showing marked economies on the basis of information to date. Honolulu Oil Co.'s division engineer, E. B. Armstrong, discussed the adaptation of both the free-type and the conventional hydraulic pump at well depths from 5,000 to 7,800 ft. Economy in equipment costs, maintenance, and operation were noted for the limited installations to this time. He reported growing interest in hydraulic pumping in the area, as deeper fields approach the end of their flowing life.

Gas lift, made attractive by a generally plentiful supply of gas in West Texas, was discussed by J. B. Harrell, Jr., of Gulf Oil Corp., principal gas-lift advocates in the area. Solution of the corrosion problem, common to all production methods was reported successful through moderate use of alloys in valves. Company figures on 162 gas-lift wells in McElroy, which in 1947 produced nearly 4,000,000 bbl., show a lifting cost estimated at 75 to 80 per cent of normal pumping costs.

Core Analysis

Two papers dealing with core analysis outlined new techniques and equipment designed for greater accuracy and precision. A new technique for analyzing unconsolidated core samples was presented by S. H. Rockwood, Shell Oil Co., Inc., Oklahoma City. Emil Kaye and M. L. Freeman, of Atlantic Refining Co., Dallas, described a new type of porosimeter. The discussion which followed these papers revealed some disagreement among engineers pres-

Southwest District officers for the coming year include, left to right: L. H. Dial, East Texas Salt Water Disposal Co., Kilgore, vice chairman for East Texas; O. W. Van Dyke, Magnet Cove Barium Co., Houston, secretary-treasurer; R. E. Bridges, Humble Oil & Refining Co., Houston, chairman; B. J. Dowd, Union Producing Co., Shreveport, past chairman and new director; and R. B. Saxe, Gulf Oil Corp., Odessa, vice chairman for West Texas and New Mexico. Not shown are: Earl M. Kipp, California Co., vice chairman for South Louisiana; J. D. Davis, Union Producing Co., Jackson, vice chairman for Alabama-Mississippi; W. H. Collins, Shell Oil Co., Inc., Wichita Falls, vice chairman for North Texas; F. E. Steele, Lion Oil Co., El Dorado, vice chairman for North Louisiana, Arkansas; and George Staples, Chicago Corp., Corpus Christi, vice chairman for Texas Gulf Coast

ent as to the advisability or necessity for obtaining certain precise measurements in view of the general estimates which geologists and engineers must often make before arriving at final determinations.

Drilling Takes Spotlight

Drilling developments gained most attention at the meeting. Three papers and considerable discussion touched on three phases of drilling—all of them including studies of cost or efficiency.

In a progress report on Humble Oil & Refining Co.'s long-range research program on drag-bit drilling, J. P. Nolley, George E. Connon, and Douglas Ragland brought out some startling facts. The study, conducted by the company's engineering division, concerns to date the effect of nozzle-fluid velocity on rate of penetration. They found drilling rate to be directly proportional to both nozzle-fluid velocity and circulation rate, using two-blade bits, in the Gulf Coast. Maximum drilling rate is obtained using maximum weight on the bit, short of balling up, hence, the velocity of the fluid stream determines the amount of weight possible to apply. They cited an example: In three wells drilled through comparable 4,400-ft. sections in Borregas field, South Texas, bit-nozzle velocities ran 90, 255, and 375 ft. per second; total hydraulic horsepower, 200, 313, and 800; and weight on the bit, 15,000, 20,000, and 30,000 lb. The three respective drilling rates attained, in feet per hour, were 28.7, 59.1, and 114. Contrary to general expectation, hole deviation at greater weights has not been unreasonably great.

Observations and laboratory tests of drag bits indicated that the jetting of mud ahead of the bit blade sufficiently disintegrated and removed cuttings to prevent balling. This proved important in using high velocities, since erosion of bit surfaces is avoided by directing mud away from immediate contact with the bit face. It was announced that new bits with selective nozzle sizes, jetting ahead of the blades, would be available soon. Recent improvement in drilling techniques has been directed principally to rock-bit drilling. This study already outlines very important means to cutting time and cost. Continuation of the study and application of findings to date in more field tests indicate that considerable progress in softer formation drilling is in the offing.

Failures Discussed

"Drill Pipe Failures, Inspection, and Protection in the Permian Basin," a report delivered jointly by W. H. Crenshaw of American Inspection Service, V. B. Bottoms, Superior Oil Co., C. N. Wallace, Western Plastic Co., Inc., and C. R. O'Dell, Tuboscope Co., showed progress in preventive measures in that area. Further data is now available on drill-pipe coating, indicating complete satisfaction on the part of operators with results to date. Inspection methods have been improved, principally by use of the sand blast which cleans the inside surfaces of pipe much more thoroughly than did wire brushing. As a result, defects are more readily detected by means of borescope and magnetic powder. Periodic inspection of strings is gaining in use in the area. Discussion following this paper, brought out the opinion, that the use of drill collars, and use of strings in tension has been the outstanding reason for reduction of pipe failures in the area.

Offshore drilling operation of the Kerr-McGee Oil Industries were described by D. A. McGee, A. T. F. Seale, and G. O. Danielson. Interest was shown in costs and precautions necessary in drilling in open Gulf waters.

In the pipe entitled "Organized Fighting of Fires and Blowouts," Jack Kinley and C. P. Parsons brought the industry up to date on the proposed Well Protection Co., Inc., which will be formed if enough oil companies and drilling contractors support it financially. A nonprofit organization, it will equip and train crews for wild-well fighting, as a sort of industry-wide fire department. Legal hurdles to participation by major oil companies were declared cleared and action was recommended by operators and Railroad Commissioner William J. Murry, Jr., who participated in the discussion following the paper.

Republic Supply Co. Is Sold to Kerr and Others

REPUBLIC SUPPLY CO., which operates 45 stores and 7 sales offices for oil-field supplies and equipment, has been sold by Republic Steel Corp. to a group of Oklahoma City oil men headed by Robert S. Kerr, former governor of Oklahoma and president of Kerr-McGee Oil Industries, Inc.

The company will continue in business under the Republic name and will operate separately from other Kerr-McGee activities. It will remain the distributor for pipe, casing, and oil-country tubular goods manufactured by Republic Steel Corp., and will continue to handle other equipment for the oil and gas industries. Republic Supply Co. now operates in Arkansas, Colorado, Illinois, Indiana, Kansas, Louisiana, Mississippi, New Mexico, Oklahoma, and Texas.

Headquarters of the company will remain in Houston, and A. B. Judd, who has been executive vice president and general manager, will become president of Republic Supply under the new management. Don L. Collins of Oklahoma City, president of Murray Tool & Supply Co., will become executive vice president of Republic Supply. The Kerr-McGee interests also own the Murray company, and the two firms may be merged eventually. H. B. Catlow, formerly sales manager of Republic Supply, becomes vice president in charge of sales. J. H. Lollar, Jr., continues as secretary and treasurer. No changes in personnel and general operating policies are contemplated by the new management.

Associated with Kerr in the purchase are other officials of Kerr-McGee Oil Industries, including Dean A. McGee, T. M. Kerr, Dean Terrill, T. W. Fentem, and F. C. Love. Purchase price was not disclosed, but it is understood the sale includes all properties and assets and that Republic Steel retains no interest in the supply company.

A Glimpse Ahead....

NEXT week's issue will be the Journal's longstanding "Annual Geologic Number"—which will cover the doings of 2,500 exploration scientists, geologists, geophysicists, and paleontologists at their joint annual meeting in Denver, April 26-29. More than 50 digests of important papers, the three presidential addresses, and a special coverage on the work of the important A.A.P.G. Research Committee will be included.

AND—a new feature: "Journal Guide to Active Fields," which is a new series reporting general drilling and development conditions in the more active of the new fields throughout the country.

ALSO—

"Canada Now Has Its Greatest Exploration Play"
"West Edmond Pilot Repressuring"
"Corrosion Tests of Refinery Heater Materials"
"New Portable Rig of Service Drilling Company"
"Skelly Fortifies Against Future Refining Problems"
"How to Survey in Brush Covered Areas"
"Refinery Burner Maintenance."

this week

TIDELANDS—Humble Oil & Refining Co seeks permit to begin drilling operations off Freeport, Tex., in Gulf of Mexico. . . . Water depth ranges from 39 to 60 ft. . . . ¶Defense officials urge Secretary of the Interior J. A. Krug to push production from offshore areas. . . . ¶Federal Communications Commission is considering assignment of radio frequencies for use in offshore geophysicar work. . . .

INTERNATIONAL—French refining industry is back nearly to prewar capacity of 162,000 bbl. daily. . . . Necessity of high output of liquid fuels limiting production of other products. . . . ¶Creole Petroleum Corp. estimates its 1948 production will be 10 per cent above 1947 output. . . . ¶Standard-Vacuum Oil Co., Anglo-Iranian Oil Co., Ltd., and certain Australian zinc interests plan extensive exploratory work in western Australia. . . . ¶Austrian oil properties remain in dispute. . . . ¶Procurement of oil under ERP will go through "normal channels" of trade, Paul G. Hoffman, administrator of economic cooperation, discloses. . . .

REFINING—Complete refinery units originally intended for Russia will be offered to oil companies for purchase in June by War Assets Administration. . . . ¶Skelly plans installation of 30,000-bbl. crude-distillation unit and a catalytic cracking unit at company's Eldorado, Kans., refinery. . . . ¶Shell officials study sites for new refinery. . . . Woodbridge and Carteret areas in New Jersey are being considered. . . . ¶Construction of Socony-Vacuum Oil Co., Inc.'s thermal cracking unit at East St. Louis, Ill., is under way. . . .

PIPE LINES—Pacific Pipe Line & Engineers, Ltd., gets contract for Salt Lake Pipe Line Co.'s 182-mile Rangely, Colo.-Salt Lake City crude-oil pipe line. . . . ¶Creole Petroleum Corp.'s Ule-Amuay pipe line in Venezuela is progressing at about 3/4 mile per day. . . .

DEMAND—Oil industry will be able to meet 4 to 5 per cent increase in demand, A.P.I. subcommittee reports. . . . Nevertheless "supply and demand promise to be in delicate balance." . . . ¶Over-all supplies of gasoline seen as adequate to meet foreseeable demand, New York petroleum group is told. . . . Domestic demand for gasoline in 1948 estimated at 6.9 per cent greater than 1947. . . .

TRENDS—Refinery crude runs for the week ended April 10 averaged 5,568,000 bbl. daily, the highest since the all-time record high of 5,637,000 bbl. for week of January 3. . . . Crude runs for the past 2 weeks have averaged 5,522,000 bbl daily. . . . ¶Daily average for crude and condensate production so far this year is 12 1/2 per cent above last year's production for same period. . . . ¶Crude production alone for the past 4 weeks has averaged 5,404,000 bbl. daily. . . . Reflecting the strong increasing demand for gasoline, stocks declined from 113,261,000 bbl. for the week April 3 to 111,589,000 bbl. for April 10. . . . Kerosine, distillate, and residual stocks were up slightly.

Pictured here are the first buildings of the new Whiting, Ind., petroleum-research laboratory of Standard Oil Co. (Ind.)—one of the largest laboratories in American industry. The buildings were dedicated last week with approximately 500 leaders in business, finance, education and science in attendance. When all units of the laboratory are completed they will house 340 chemists, chemical engineers, physicists, entomologists and other scientists, along with 800 technicians and other assistants. Principal speakers on the program for the dedication of the new laboratory included: Dr. Arthur H. Compton, chancellor of Washington University, St. Louis, Mo.; Dr. Robert E. Wilson, chairman of the board of Standard Oil Co. (Ind.); and A. W. Peake, president of Standard Oil Co. (Ind.)

ERP Oil to Pass Through Normal Trade Channels, Hoffman Declares

WASHINGTON.—Procurement of oil under the European Recovery Program will be handled through the "normal channels" of trade, but the Government will maintain surveillance over prices and terms of contracts, it was disclosed last week by Paul G. Hoffman, Administrator of Economic Cooperation.

"Letters of intent" to negotiate the bilateral agreements which are required under the law before the European countries can take advantage of the American aid program have already been filed by the 16 western European nations, paving the way for the immediate acquisition of goods and materials in this country. Because of particular conditions which do not apply to other countries, a somewhat different procedure is being followed with respect to bizonal Germany and China.

Hoffman said he had not yet determined upon the shape of his organization, but it would be kept very small and the various government departments and agencies would be depended upon for all technical information and advice. He said no important staff appointments would be made until the Senate has confirmed his roving ambassador and deputy, two key positions, and indicated it was not proposed to set up any elaborate commodity group.

Procedure Outlined

The procedure for the procurement of oil and most other commodities except agricultural, which will be purchased through the Commodity Credit Corporation and Quartermaster General's office, as outlined by Hoffman, will be somewhat as follows:

Foreign governments desiring to purchase oil will first have to secure formal approval in the shape of a requisition authorizing the purchase. In some cases, procurement and payment will be made by the receiving government, which will be reimbursed by the United States, while in others the arrangements will be made by the receiving government, payment will be made direct by the United States.

ECA officials will discuss commitments with the individual nations immediately, and each country will submit quarterly programs.

Not yet undertaken, restrictions will have to be worked out for foreign governments doing their own purchasing, with regard to price and other terms of sales they are permitted to arrange. Some restrictions will be incorporated in the authorizations to proceed with purchases. No decision has been reached yet as to whether ECA will have to pass on all purchase contracts or leave that to the Department of Commerce, which could do so in the exercise of its export controls.

Hoffman made it clear there are many important problems with which the ECA has not yet come to grips. He was unable to give any answer, for instance, to the question of what could be done in event a foreign country seeking to buy heavy machinery, steel, or other scarce commodities was unable to find a supply.

Phillips Planning Gulf Coast Expansion

HOUSTON.—Phillips Petroleum Co. has plans for further expansion in the Gulf Coast area involving a gasoline plant, petrochemical facilities, increased refining capacity, and a possible new pipe line, it was revealed here last week by K. S. Adams, Phillips president.

Adams and 20 other Phillips officials were in Houston during a 2-day inspection trip of the company's South Texas properties.

The Phillips head said the company definitely has decided to build a $5,000,000 natural-gasoline absorption plant in Chocolate Bayou field, Brazoria County, which has largely been developed by Phillips. Work is expected to start in the near future on the plant, which will have a minimum capacity of 100,000,000 cu. ft. daily.

Gas from the field at present moves to Pan American Refining Co.'s refinery at Texas City, and Pan American will continue to receive the residue gas after processing in the new Phillips plant. Phillips personnel are to build the installation.

Phillips is now waiting information from War Assets Administration to learn if its high bid for the Government ammonia plant at Etter, Moore County, in the Texas Panhandle, has been officially accepted. If the company acquires this property, Adams said, it will spend $6,000,000 to $10,000,000 for other chemical facilities on the Houston Ship Channel to manufacture ammonium sulfate fertilizer.

Site of this plant would be a 300-acre tract near Pasadena now used by Phillips as a gasoline terminal. Adams pointed out that the market for fertilizer is now spotty, but said the company could quickly turn to the manufacture of other chemicals if necessary.

Work is now under way by Alamo Refining Co., a Phillips affiliate, rearranging process facilities at the refinery near Sweeny, in Brazoria County, which Alamo bought from the Government after the war. The plant is now running about 35,000 bbl. daily, and with completion of the expansion, capacity will be raised to 45,000 bbl. daily.

Another tentative Phillips project is a 165-mile pipe line from the Corpus Christi area to the Sweeny refinery. Plans for this line are still in the consideration stage.

Adams said Phillips now has an investment of about $150,000,000 in its Texas operations, much of it in South Texas. The company is considered one of the most rapidly expanding operators in the Gulf Coast. It began marketing in the area about a year ago, subsequently purchasing 184 stations and bulk plants from Pure Oil Co. and others.

Mississippi Becomes Member of Compact

Gov. Fielding H. Wright has signed the Interstate Oil Compact Commission agreement, bringing in Mississippi as the twentieth member of the Compact.

Membership of the 13-year-old Compact now includes states producing more than 80 per cent of the nation's oil and 90 per cent of the natural gas.

Governor Wright recently signed into law the new Mississippi oil and gas conservation law, which creates an oil and gas regulatory board of five members.

Continental Merger to Be Proposed May 11

A proposal of a merger of Texon Oil & Land Co., Group No. 1 Oil Corp., and Group No. 2 Oil Corp., with Continental Oil Co., will be made at the stockholders meeting of Continental May 11, according to the proxy statement which is being mailed to Continental stockholders.

Continental owns 89 per cent of the outstanding stock of Texon, which in turn owns 73 per cent of the outstanding stock of Group No. 1 and 79 per cent of Group No. 2.

If the merger is completed, the stockholders of the three subsidiary companies will receive an aggregate of 76,305 Continental shares.

Plans Outlined for International Oil Congress With Exposition

A 3-DAY, world-wide oil forum, the International Petroleum Congress, will be conducted during the 1948 International Petroleum Exposition, which will open in Tulsa May 15.

Discussions of current oil research, future prospects, and problems facing the industry on an international scale will feature the meetings of the congress, which is expected to be attended by several hundred government officials and oil-industry representatives from more than 30 countries.

The congress will be opened on May 18 by Gov. Beauford Jester, of Texas. Jester was chosen, according to Alf G. Heggem, vice president of Orbit Valve Co. and chairman of the congress, because of his position as head of "the world's largest and most important geopolitical unit in crude-oil production" and his widely publicized fight for state ownership of the tidelands.

Speakers will include N. E. Tanner, Canadian minister of lands and mines, Edmonton, Alta.; Antonio J. Bermudez, general manager of Petroleos Mexicanos, Mexican Government oil agency; Benjamin Fairless, president of United States Steel Corp., Pittsburgh; Charles Kettering, General Motors Corp., Detroit; and Dr. Gustav Egloff, Universal Oil Products Co., Chicago.

Negotiations are currently under way with other oil-industry and business leaders, who are being asked to present brief papers on pertinent subjects during the congress.

Originally it was not planned to hold the congress during the 1948 exposition, Heggem said, but plans were altered after oil men from throughout the world asked I.P.E. officials to hold the two events simultaneously.

All sessions of the congress will be of the open-forum type, with meetings being open to any member of the industry wishing to attend. Abstracts of all papers presented during the meeting will be prepared and published. Translators also will be provided for the benefit of visitors not familiar with the English language.

Opening on May 18, the congress will recess the following day, resuming its meetings May 20 and continuing on May 21. All sessions of the congress will be held in the north and south auditoriums of Central High School in downtown Tulsa.

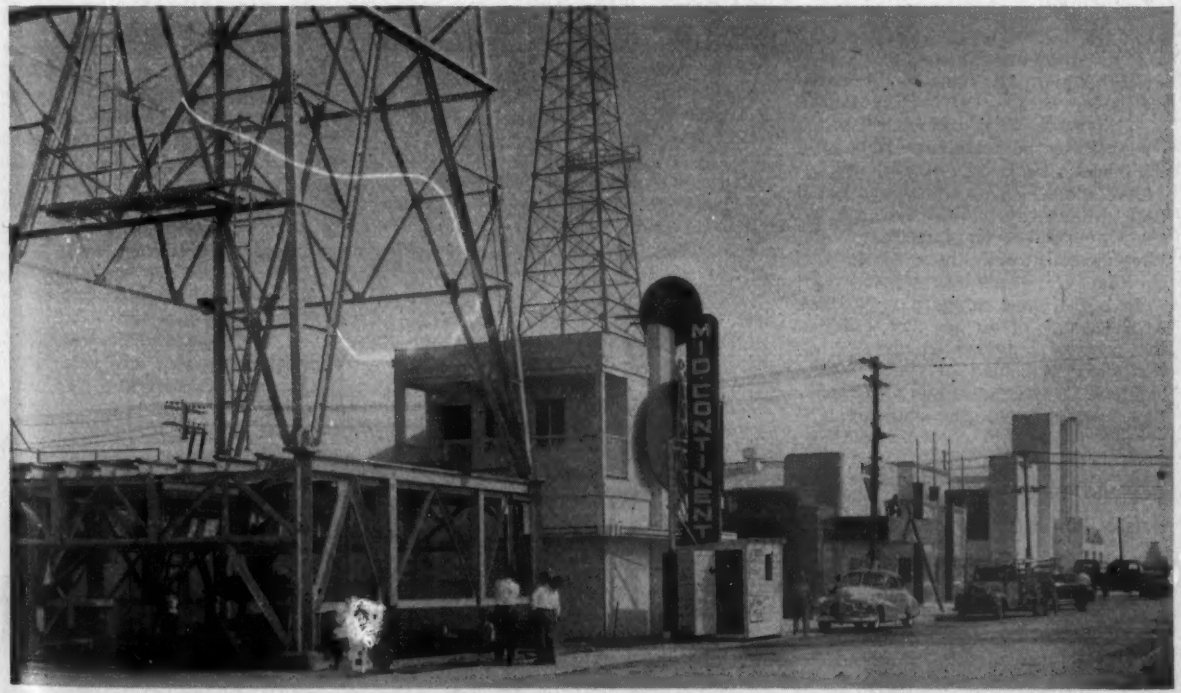
The program tentatively calls for discussions on international personnel and public relations of the oil industry on the opening day, discussion of practical application of postwar processes and techniques on May 20, and consideration of future industry developments on the closing day of the congress.

Humble Reveals Plans For Deep-Water Drilling

HOUSTON.—Plans for drilling operations in open Gulf of Mexico water 39 to 60 ft. deep off Freeport, Tex., were disclosed by Humble Oil & Refining Co. in a request for a Department of the Army permit authorizing the necessary construction.

Humble asked the Army Engineers office in Galveston for a blanket permit for oil-development work in an area including portions of 11 state tracts and totaling 19,040 acres central to a point about 7 miles east of the Freeport harbor jetties at Freeport.

In asking the permit, the company said the foundation of the drilling structures would consist of steel piles driven within pipe templates and cross braced, or steel piles anchored to vertical steel piles driven to a top elevation of 15 ft. below the bottom of the Gulf.



This view looking south down Drake Drive on the International Petroleum Exposition grounds illustrates the progress made in recent weeks in preparing the grounds for the opening of the world-wide exposition May 15. In the left foreground is the derrick of Mid-Continent Supply Co., adjacent to the company's headquarters building. Installation of draw works and other equipment is scheduled in the near future. In the right background is the main entrance of the Texas Building, one of the largest exhibit buildings on the grounds

World-Wide Progress in Field of Chemistry Outlined Before A.C.S.

by Arch L. Foster

CHICAGO.—The strong impetus of developments hastened during World War II was evidenced in the outstanding achievements announced this week at the 113th national meeting of the American Chemical Society here.

That progress is being made in other countries in the development of chemical and allied sciences, and industries based on them, was indicated by international speakers before this assembly of members of the largest scientific body in the world.

Great Britain is looking to her chemical industry to tide her over the "rough road" to recovery from the war; Russia is stressing certain phases of chemistry and engineering but falling behind in others; and France and other European and Asiatic countries are concentrating whatever resources they can salvage from war to further chemical-industry advancement, speakers told the gathered scientists.

Government Program Opposed

The oil industry can best meet the enormous demand for petroleum products and is better qualified than are government agencies to develop whatever synthetic fuels may be needed in the future, Dr. Gustav Egloff, of Universal Oil Products Co. and chairman of the petroleum division of the society, declared.

The nine billion dollar synthetic-fuel program proposed recently by the Government is unnecessary, Egloff insisted, since there is no real shortage of petroleum.

To build plant capacity to produce 2,000,000 bbl. of oil per day will cost the country between 20 and 30 billion dollars instead of the 9 billion estimated by government officials. The program would, he said, consume 468,000,000 tons of coal per year, or two-thirds of our present coal production. Construction of large commercial synthetic-oil capacity now is considered premature, Egloff added.

Research Important

England is relying on science and technology to "pull through," Sir Arthur P. M. Fleming, director of research for Metropolitan-Vickers Electrical Co., Ltd., told the chemists as he warned of the strong possibility of another war.

A strong industry and a prosperous people are England's best support in its war against subversive activities among its people, Fleming said. He defended the British Government's imposition of controls, saying that social reform was long overdue there and could not be postponed further in the face of the hardships inherited from the second World War.

Research, he said, is now accepted as an integral part of national policy, and the government has established a committee on industrial productivity to study ways by which new discoveries may be applied quickly to everyday factory operations.

Russian Progress Slow

Russia has made little progress in developing synthetic oil in spite of her great need for gasoline and other petroleum products, according to Dr. J. G. Tolpin, Russian literature research scientist for Standard Oil Co. (Ind.). This, he said, is based on the lack of published data on this subject in Russian technical literature.

Soviet chemists, he said, have concentrated search on some lines of chemicals from petroleum, but no large-scale manufacture of these chemicals is reported in Russian literature, with a few exceptions such as naphthenic acids used in making fungicides.

Indications are found in Russian sources of large consumption of oxygen in the underground gasification of coal, which the Russians are known to have been studying for a long time, he said. Coking of oil shale on large scale may be started soon, he added.

High Yields From SiO_2-MgO

Newly developed silica-magnesia catalysts are superior to silica-alumina catalysts in cracking heavy oils so far as gasoline yields are concerned, reported R. W. Richardson, F. B. Johnson, and L. V. Robbins, Jr., of Esso Laboratories. This new catalyst is also superior in its maintenance of catalytic activity, they have found in research in small and large pilot plants. Octane ratings of the motor fuels produced by the silica-magnesia are lower than those of silica-alumina cracked fuels, and approach the ratings obtained with natural catalysts. The yields of natural catalysts (clay types) are usually between those from the other two types of catalysts, they find.

As a result of this research commercial production of the silica-magnesia catalyst is under way, Richardson said. The yields of dry gas, butanes, and butenes are lower for the magnesia-containing catalyst than with alumina-silica, which carbon formation is about equivalent to that obtained with silica-alumina. The operation with this new catalyst with regard to carbon burning rate, catalyst attrition, and commercial regeneration is expected to be satisfactory, based on pilot-plant results to date.

Typical results on the same charge stocks show 52 per cent gasoline yield, of 78.2 MM octane number from silica-magnesia, compared to 42 per cent yield of 80.8 octane number fuel with silica-alumina, and 46.2 per cent gasoline of 78 MM octane number gasoline with natural catalyst, from a light gas oil. Wide-cut gas oil (paraffinic) gave 59 per cent gasoline of 80.4 MM octane number from the magnesia catalyst; 47.6 per cent yield of 82.6 MM octane number fuel from the alumina type. Volatility of the silica-magnesia-produced motor fuel is somewhat lower, generally, than those from silica-alumina or natural catalysts, for the same vapor pressure.

Quality of heating oil produced by the silica-magnesia is about the same as that from silica-alumina, higher than that from natural catalyst. Comparative activity of a silica-magnesia catalyst after heat treatment at 1,400° F. for 3 hours was 56; that for the alumina was 50, for natural acid-treated clay, 36. Activity after steam treatment for these three catalysts, respectively, was 42, 25, and 33.

Yields and octane numbers (MM) from wide-cut gas oil at 975° F., in a 100-bbl.-per-day charge pilot unit, from silica-magnesia, silica-alumina and natural-clay catalysts were, respectively; 56.2 per cent, 79.2; 45.5 per cent, 81.6, and 47.8 per cent, 79.8. Composition of some of these products show the following:

	Light naphtha		Heavy naphtha	
Catalyst composition:	SiO_2-MgO	SiO_2-Al_2O_3	SiO_2-MgO	SiO_2-Al_2O_3
Aromatics	2	5	30	67
Naphthenes	13	25	26	21
Acyclics	85	70	44	12
Olefins	68	64	45	26

Quick Starting for Diesels

Inherent difficulties in starting diesel engines at temperatures below freezing have been reduced and largely eliminated by recent developments, F. L. Nelson and M. Smolak of Socony-Vacuum Oil Co.'s Paulsboro laboratories told the Petroleum Division of the American Chemical Society here.

Addition of ethers to the fuel per-

mits easy starting at temperatures as low as minus 40° F., these researchers stated. Much of this technique was developed during the recent war; ethers (for example diethyl or anaesthetic ether) is effective in promoting starting but is dangerous when not applied properly.

Additives which have proved especially effective for this purpose include high-cetane-number volatile petroleum compounds. One problem, to obtain high enough cranking speeds at low temperatures, has been minimized by the installation of 24-volt starting equipment and use of high-quality, very low pour-point lubricating oils.

Proper blending of the components of spark-ignition motor fuels has been promoted by wartime studies on the susceptibility of various types of fuels to tetraethyl lead, D. P. Heath and J. S. Hicks, also of Socony-Vacuum laboratories, declared. Ability to predict the octane number of a blended fuel from components used, and to determine the effect of TEL on the octane rating of blends, has made it possible to determine the best blending procedures to use in the refinery, these authors said.

Butadiene Specifications

Development of specifications for butadiene, main component of GR-S, or tire-type, synthetic rubber, was a most urgent problem during the early war years and offered serious difficulties, James H. Boyd, New York consulting engineer, told the chemists when discussing the present state of these specifications. Some impurities retarded polymerization rates prohibitively, while other impurities catalyzed the formation of these "retarders." One of the main retarding impurities was pentadiene, which was eliminated by very precise fractionation from the butadiene fraction. Peroxides formed during shipment or storage catalyze the formation of polymers which are retarders. The introduction of 0.02 per cent of paratertiary butyl catechol was found to inhibit sufficently this peroxide formation.

In another case, privately-manufactured butadiene which contained very small amounts of chlorine products caused trouble by concentration of the chlorine by recycle; this material was useful in N-type rubber synthesis, but could not be used for GR-S rubber. Present specifications require a butadiene of 98 per cent minimum diene content; 10 parts per million of peroxide as H_2O_2; sulfur, 100 p.p.m., max.; butadiene dimer, 0.2 wt. per cent, max.; inhibitor content, tank cars, 200 p.p.m. of TBC (p-tertiary butyl catechol). For current operating conditions the butadiene specification conditions appear to be solved, Boyd stated. However, "Such a specification can never be a static thing, but must ever grow and change as its product lives a wider and more useful life."

Shell Synthesizes Varnish

A completely new type of varnish, synthesized entirely from petroleum, has been perfected by Shell Development Co., H. Dannenberg, T. F. Bradley, and T. W. Evans told paint, varnish, and plastics chemists at Chicago. This product is derived from a new chemical developed by Shell scientists, Glycerol allyl ether, at the Emeryville, Calif., laboratories. The material forms insoluble films of very high mechanical and chemical resistance. By reacting this ether with acids analogous to those employed in the synthesis of alkyd-type resins, such as phthalic anhydride, the varnish base is obtained without the use of scarce natural drying oils.

Heavy Fuel Oil From Coal

A heavy, residual-type fuel oil can be produced from coal at a cost competitive with petroleum residues in some parts of the country, H. H. Storch and collaborators in the U. S. Bureau of Mines reported to the society. The powdered coal is made into a paste by suspension in a heavy-oil (liquid) fraction, and special catalysts are mixed therewith. The mixture is heated to 780°-900° F. and its pressure raised to 1,000-10,000 psig. Molecular hydrogen is introduced to react with the powdered coal to form the liquid.

Alkylation Theory Wins Medal

Development of a theory which explains the mechanism of the alkylation of isoparaffins with olefinic hydrocarbons has resulted in the presentation of the first Ipatieff Award to Dr. Louis Schmerling of Universal Oil Products Co. The Award was established by Dr. V. N. Ipatieff, head of the Ipatieff Pressure and Catalytic Laboratory at Northwestern University, Chicago, and Mrs. Ipatieff, and is in the sum of $3,000 to be given each 3 years to the chemist under 40 years of age who shows most outstanding achievements in the fields of high pressure and catalytic chemistry. It was established in 1947 and the award to Dr. Schmerling is the first to be made.

Dr. Schmerling's theory of the reactions which result in the production of alkylate, made and used in huge quantities in aviation gasoline during the war, includes three steps: (1) isoparaffins are changed into tertiary alkyl esters in cooperation with catalysts; (2) the esters combine with the olefin to form the alkylate molecule; (3) more isopariffin is brought into reaction, forming more ester and the cycle is continued.

Plastics called S-polymers, made entirely from petroleum, show remarkable ability to preserve fruits, vegetables, tobacco and other materials when used as a protective coating, R. G. Newberg of Standard Oil Development Co. and O. C. Slotterbeck of Esso Standard Oil Co., said. These are thermoplastics, and show high resistance to passage of moisture and gases. Vegetable materials stored for 6 months within an envelope made of S-polymers at 70°-95° F. showed all the properties of fresh products, with no deterioration, mold or offensive odors. The polymers have also shown excellent properties when employed as insulation for electrical equipment, gaskets, packings, and for waterproofing paper.

Polyisobutylene Used Widely

Polyisobutylene is one of the most widely used intermediates in the field of petroleum-derived chemicals, Vandeveer Voorhees, patent attorney for Standard Oil Co. (Ind.), told the high-polymer forum (which is sponsored by seven professional divisions of the Society). It is employed in such greatly differing products as face creams, rubber, paints and machine greases, he said.

Holding air much better than do natural or other synthetic rubbers, butyl rubber is employed for making inner tubes for automobile tires. Isobutylene is the main ingredient in butyl rubber, via polymerization with small amounts of butadiene, isoprene or other dienes. Its chemical stability or inertness approaches that of paraffin waxes, and it can be and is used in place of wax in many applications, Voorhees said. It may vary from a sticky grease to a rubber-like solid depending on the conditions of its polymerization. Lubricating greases made with it do not drip, although they flow easily under slight pressure (advantageous in lubricating textile machinery). Isobutylene is polymerized at very low temperatures—dry ice being used to reach —80° F.—at which temperature the polymerization reaction is complete in 5 minutes or less. Discovered in Russia in 1873, this polymer came into prominence only 20 years ago, and 200 patents have been issued regarding its use in the United States during this recent period.

Lone Star Contracts for Large Hypersorption Unit

Lone Star Gas Co., Dallas, Tex., has contracted with Foster Wheeler Corp., New York City, for the installation of a hypersorption unit which will process 60,000,000 cu. ft. of gas daily for the recovery of propane and for the dehydration of stripped gas.

This unit will operate at 325 psig. on gas containing about 8 per cent propane. The unit is designed to operate economically with 3 per cent propane in charge gas. It is also equipped with side-cut tray for ethane recovery if desired at a later date. The installation will use the principle of multi-feed inlets increasing the unit's maximum capacity.

International

WORLD-WIDE OIL DEVELOPMENTS

Creole Predicts 10 Per Cent Gain In Crude Production in 1948

CREOLE PETROLEUM CORP., the largest oil-producing company in the world, estimates that its 1948 production will be approximately 10 per cent above the 1947 output of 589,442 bbl. daily.

However, A. T. Proudfit, Creole president, stated in the company's annual report for 1947 that "as the rate of production reaches such high levels, it becomes increasingly difficult to effect important percentage increases, both on account of the effort required to maintain the present rate, and the difficulties still being encountered in obtaining materials vital to our needs."

At the present, Proudfit added, the procurement of steel products in general, particularly pipe, presents a serious problem.

Creole's 1947 crude-oil production of 589,442 bbl. daily represented an increase of 8.1 per cent over 1946 and was 49.5 per cent of Venezuela's total output.

Reinvestments Set Record

Reinvestment of capital by the company set a new record in Venezuela during 1947 as Creole made capital expenditures of $122,463,279. The figure is an increase of nearly 76 per cent over 1946 expenditures of $52,809,866, the largest previous sum reinvested.

Investment in 1948, the report said, will be still greater because increasing demand for products requires new plant facilities that are becoming increasingly costly to build.

Drilling in the Bachaquero area, south of Lagunillas on the east shore of Lake Maracaibo, was resumed last year. Twenty-six wells were drilled with a total production of 9,000 bbl. daily.

New development programs in Temblador field in southern Monagas and in the Tucupita area of the Federal Delta Territory were initiated in 1947 to increase heavy-oil production. Pedernales field, on the Gulf of Paria, was placed back on production. Pedernales has been closed down for 5 years due to lack of market outlet for the quality of crude oil which it produces.

Reserves Increased

As in 1946, wildcat drilling was largely confined to the evaluation of exploration concessions, the terms of which required that selection be made in 1947 and 1948 of the areas which the company desired to retain for development.

Additions to crude-oil reserves during the year resulted from step-out drilling in Mara, the Bolivar Coastal field, Quiriquire, and Tucupita. The most notable development was the completion of Creole's first well in Mara field, which was discovered by competitors in 1945. The wells drilled so far by the companies operating in this field have been prolific, the first Creole well having had an initial daily production of 5,950 bbl.

No Concessions Granted

Disappointing results of drilling in Barbacoas, where 10 wells have been completed yielding only noncommercial quantities of gas, resulted in the retention of only 25 per cent of the concession area as development parcels. The full 50 per cent of both the Temanaco and West Lake Maracaibo exploration concessions was converted to development status.

Creole carried on extensive geophysical and surface geological surveys last year, principally in connection with the evaluation of exploration concessions. No new exploration concessions were granted by the Venezuelan Government in 1947.

Creole operated its two Venezuelan refineries, at Caripito and La Salina, at capacity. The average crude run during the year at both refineries was 59,210 bbl. daily.

Because of the notably increased demand for diesel and residual fuel oil, the company's 60,000 bbl. daily Amuay refinery is being designed to concentrate on heavier oils. Eventual cost of this plant, which is now under construction, may be upwards of $120,000,000.

Directors present at the recent Creole board meeting in Caracas are shown here at a press conference which followed. Left to right are J. T. Fly, George L. Burr, E. J. Mundy, H. W. Haight, A. T. Proudfit, H. F. Prioleau, W. M. Hall, and R. H. Sherman

Cities Service Deal Clarified

As Mexico Woos U. S. Operators

International

NEW YORK.—The contract between Petroleos Mexicanos and Cities Service Co., whereby the American oil company will resume operations in Mexico and in effect will have first call on any crude produced from certain properties, has been approved by the "Sindicato" of Mexican labor unions, a circumstance which is hailed as a definite achievement.

Clarification of this contract has taken more than 15 months and was signed only last week. *(The Oil and Gas Journal, April 15, page 58.)*

Instead of making an outright loan of several millions of dollars, as was indicated in first reports of this deal, Cities Service and the Mexican Government will, from time to time, review proposed exploratory and drilling programs and plan accordingly, with the American company furnishing certain technical and administrative abilities.

While Pemex will be in direct charge of all drilling activities and may hire independent drilling contractors, it is understood that Cities Service will help Pemex to obtain necessary equipment in the United States.

Exploration Starts Soon

Exploration activities will start immediately. A certain amount of geological work had been carried on by Cities Service before 1938 when the Mexican Government expropriated practically all British and United States oil properties. An exception was made in the case of the Cities Service concessions, which were held by agreement with the Mexican Government in status quo.

Under the present contract, Cities Service has sold the five areas involved to the Mexican Government and in return gets certain rights on the crude oil produced. In 1942 this company sold certain other Mexican properties to the government, but the 1942 sale of properties presumably is not a matter of concern now.

Indicative of the probable crude-oil reserves in the areas which are involved in the contract signed last week is the fact that small oil wells were brought in, in the 1930's, in San Jose de las Rusias, Sabino Gordo, and Santiago de la Pena, three of the areas covered by the contract. Mexico's prolific Panucio oil field is only 40 miles from the southern end the Sabino Gordo. At Buena Vista de la Papayas and La Mission y Mogote, Cities Service had previously carried on certain geological work.

Commenting on this contract, one well-informed source stated that it is the only type of oil contract which can be obtained today in Mexico. By this he meant that not only does the Mexican constitution and oil law prohibit any other type of contract but—most important—it is the only type of contract which the labor unions will approve. Three members of the "Sindicato" are on the Pemex board of directors.

A contract proposed to Pemex by J. Edward Jones, Texas operator, now appears to be virtually dead, having been variously reported, in both Mexico and the United States, as abandoned and revived during the past several months.

Mexican activities of Gordon Duke, president of Southeastern de Mexico, were highlighted this week by the disclosure that Gen. Manual Zevada, who played a prominent role in the "Zevada-Cook oil settlement" following expropriation, has joined Southeastern and shortly will head an affiliate of that company to perform certain drilling operations. Consummation of this proposed deal will be on a drilling-contract basis.

General Offer Revealed

In the past several weeks there has been considerable discussion in oil circles over another type of contract which Pemex and the U. S. State Department have been showing interested oil companies. For some undisclosed reason, considerable secrecy has surrounded this contract, which is entirely separate from the Cities Service deal.

While many United States oil interests—majors and independents—are interested in entering Mexico, it appears that most of them will not accept all the present terms of the Petroleos Mexicanos contract which U. S. Ambassador Thurston recently brought back from Mexico City.

Additional information about this proposed type of contract was given to The Oil and Gas Journal this week. Possibly the most interesting, and puzzling, proposal in the contract is a stipulation that even after an outside oil company had spent considerable sums of money in finding new oil reserves Pemex would reserve the right to prevent such a company from enjoying a reasonable financial reward.

Specifically, the Pemex contract states that the oil company, or contractor, may sell his percentage of the new crude oil produced as a commission agent, or purchase from Pemex a percentage of the crude oil he has discovered. However, Pemex reserves the right to prevent either of these alternatives if it is decided that there is not sufficient crude oil being produced to satisfy Mexico's domestic demands. Oil men contacted in New York have stated flatly that they do not understand the proposals.

Could Not Appeal

Another factor which is not looked on too favorably by some United States oil men is the Pemex proposal that all disputes would be referred to the federal courts in Mexico City and that under no circumstance would the outside company appeal to its own government for aid or advice, under penalty of losing all its rights and properties in Mexico.

The question of whether a company, which might be in dispute with Pemex over some detail, actually did appeal to its own government would, in the last analysis, be decided largely by Pemex.

As a matter of fact, this part of the Pemex contract is not in accord with the full information which the U. S. State Department and oil companies now make available to each other in matters concerning foreign oil operations elsewhere. Therefore, it is likely that the U. S. State Department, as well as the oil companies, might protest this part of the contract.

Still another feature which oil companies do not like in the projected Pemex contract is the proposal that Pemex would decide, after the discovery of a commercial oil or gas field, whether storage tanks, along with terminals and pipe lines, were to be built. The contract also proposes that the companies would furnish funds for such construction, under conditions set by Pemex.

No Obligations

Another stipulation in the proposed contract which appears to be rather stiff, insofar as many American oil men are concerned, provides that Pemex would not be obligated to reimburse an oil company for any expenditures if a company failed to find new oil reserves within a 5-year period. It is pointed out that after extensive and costly exploratory work was accomplished and sites selected for drilling that a company might be on the verge of an important discovery just as the 5-year period ended.

A company's programs and budgets would be subject to Pemex approval, with the right of appeal by the company if it did not agree. However, even this proposal is considered too binding by many oil men. The company would also have to obtain approval of proposed drilling sites.

French Refining Industry Back to Prewar Output, Moving Ahead

by Warren W. Burns

AT the beginning of 1948, the French refining industry had recovered 90 per cent of its prewar capacity of approximately 8,100,000 tons per year, or about 162,000 bbl. a day. As of this month, recovery is practically 100 per cent.

However, reconstruction of French refineries, many of which suffered heavy war damage, has been designed to obtain the maximum amount of products, and while the comparison of total output, prewar and today, appears the same, the quality and number of products are not.

In fact, during this initial period of postwar reconstruction, the demand for gasoline and fuel oil has been so great that French refineries have been forced to produce as much of this type liquid fuel as possible and still meet minimum specifications for the different finished products.

Gasoline manufactured by the French refiners today is 65 octane, which is low compared with standards in the United States but high enough for the type of motor vehicles which are now on the highways of France. Cracking is limited to a few refineries and involves only a small amount of products.

Lube Output Limited

While it was hoped to resume the manufacture of lubricating oils on a larger scale this year, it appears that it will not be possible to get the solvent process units in operation. Meanwhile, only the acid and clay units are operating. France is importing practically all its viscous oils in a refined state and a considerable percentage of her motor oil needs. Most of these imports are coming from the United States. Operation of several wax units has been resumed, but France still relies heavily on United States wax imports, as the output is modest.

French refining capacity at the end of 1947 was approximately 6,200,000 tons annually, or 124,000 bbl. daily, compared with 1,500,000 tons annually, or 30,000 bbl. daily in 1945. This increase has been accomplished in the face of grave shortages of equipment, particularly steel. At every stage it was necessary to improvise. Cracking units were converted into topping units, and necessary equipment was designed from whatever was on hand.

Immediately before the war, France had 15 refineries with a total output of 180,000 bbl. a day. Four years later, bombing and wilful destruction had reduced the daily output to 39,000 bbl. from three refineries. The European Economic Coordination Committee which met in Paris last September, estimated that 165,000 bbl. of crude must be processed in French refineries between July 1, 1948, and June 30, 1949. It now appears that at least 200,000 bbl. daily will be processed during that period.

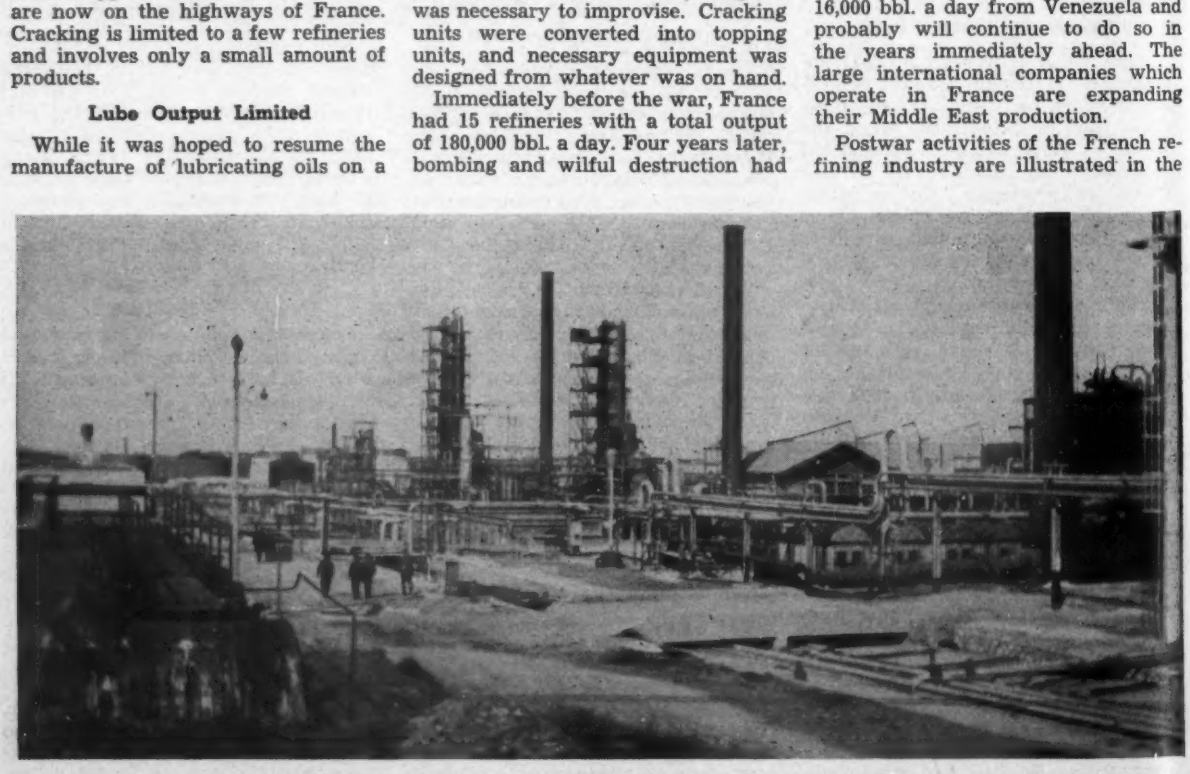
Expansion Planned

These figures emphasize how much work has actually been accomplished during the last 3 years of material scarcities when it was necessary to repair existing plants and adapt them to intensive production of products in great demand. Having now reached the limit of what might be reasonably expected with improvisation and emergency solutions, France is going ahead with plans to expand refineries by erecting new installations within the existing plants in order to minimize investments and new equipment.

The French refinery expansion program is included in the European Recovery Plan. It is expected to bring the daily output to around 345,000 bbl. by 1952. Approximately 216,000 tons of steel, to be supplied largely by the French steel industry, will be necessary, as well as $36,805,000.

Crude oil for the expanding refining industry will come from the increased output in Iraq. France expects to get at least 150,000 bbl. daily from Iraq by 1952. Cie. Francaise des Petroles now is lifting upwards of 16,000 bbl. a day from Venezuela and probably will continue to do so in the years immediately ahead. The large international companies which operate in France are expanding their Middle East production.

Postwar activities of the French refining industry are illustrated in the



General view of L'Avera refinery on the Mediterranean shore of Societe Generale des Huiles de Petroles, subsidiary of Anglo Iranian Oil Co.

accompanying table. Other highlights are outlined below.

Provence Refinery Restored

Cie. Francaise de Raffinage, an affiliate of Cie. Francaise des Petroles (which is 35 per cent owned by the French Government) had two refineries before the war—one in Normandy, near Le Havre, and the other in Provence, in the south of France near Marseilles. The Normandy refinery had a daily capacity of 35,000 bbl. It was completed in 1933 and included several topping and cracking units, one SO_2 refining unit and a paraffin wax plant. It ran largely on American crudes. The Provence refinery, completed in 1935, had a distillation capacity of 20,000 bbl. Its equipment included a combined unit for topping, cracking and a reforming plant which operated largely on Iraqian crudes.

At the Provence refinery, a few storage tanks were damaged by bombing, while the Normandy refinery's tank farm was completely destroyed and the main topping units and other modern equipment shipped east by the conquering forces. In July 1946, the Normandy refinery went back on stream, using American crudes, and had a processing capacity of 14,000 bbl. daily. By the end of 1947 this refinery, using the maximum capacity of all units in operating condition, processed 26,000 bbl. daily and had a reconstructed tank farm capable of storing 2,000,000 bbl. of crude and finished products.

A distillation unit, on order in the United States, still remains to be installed to complete the reconstruction

at Normandy. The original unit was removed by the Germans in 1942.

The Provence refinery has been back on stream since 1945, and by utilizing the full capacity of all available units has had an output of 50,000 bbl. daily.

To Increase Capacity

C.F.R. plans to increase the total refining capacity of its two plants to 84,000 bbl. daily by the addition of 20,000 bbl. daily distillation unit at Provence. Moreover, to obtain the fullest value from Iraqian crude and

(Continued on page 159)

FRENCH REFINING INDUSTRY AT A GLANCE

(To convert tons per year into barrels daily, approximately, divide by 50. To convert tons daily to barrels daily, multiply by 7.5. To convert lubricating-oil figures to barrels daily, multiply by 7)

Company and group—	Location	Tons per year: Maximum prewar cap.	Tons per year: Capacity in 1945	Tons per year: Midyear 1947 operating cap.	Crude processed	Cracking: Type	Cracking: Capacity tons/day	Lubricating: Type	Lubricating: Capacity tons/day	Other
Cie. Francaise de Raffinage, Cie. Francaise des Petroles	Gonfreville	1,600,000	.....	1,200,000	E. Venezuela Gulf Coast	2 Cross	*900	....	....	Wax
		*.....	.....	.....		1 Reforming	*380	....	....	.....
Cie. Francaise de Raffinage, Cie. Francaise des Petroles	La Mede-Les Martigues	.....	.....	.....	.....	1 Visc. break.	(*)	....	....	.....
		900,000	900,000	1,200,000	Iraq	Cracking	*500	....	....	Asphalt
						Reforming	*300	....	....	.....
Standard Francaise des Petroles, Standard (N. J.)	Port-Jerome	1,200,000	.....	1,200,000	Venezuela	3 Tube and Tank	1,300	Phenol*	400	Asphalt
	Notre Dame de Gravenchon	.....	.....	.....	Middle East	(Five Lille)		Clay	150	.....
Ste. Anonyme des Petroles Jupiter, Royal Dutch-Shell	Petit-Couronne	750,000	.....	600,000	Venezuela	Dubbs	600	Acid-clay	80	Asphalt
		.....	.....	.....	Middle East	Dubbs (R)	300	Edeleanu	50	.....
Ste. Anonyme des Petroles Jupiter, Royal Dutch-Shell	Pauillac	540,000	.....	.....	.....	Dubbs	†600	....	....	.....
		.....	.....	.....	.....	Dubbs (R)	300	....	....	.....
Ste. Generale des Huiles de Petrole, A.I.O.C.	Courchelettes	300,000	.....	.....	.....	1 Cross	200	SO_2 Benzol	70	.....
								Acid-clay	140	.....
Ste. de Raffinage des Huiles de Petrole, A.I.O.C.	L'Avera a Martigues	550,000	550,000	800,000	Iran	Crack. Cross	500	....	....	.....
		.....	.....	.....	.....	Ref. Cross	*500	....	....	.....
Cie. des Produits Chimiques et Raffineries de Berre, Cie. des Produits Chimiques de St.-Gobian	Berre l'Etang	600,000	350,000	680,000	Gulf Coast	1 Cr. Cross	*350	Acid*	....	A-W
		.....	.....	.....	.....	1 Houdry	*600	Clay	....	.....
Raffineries de Petrole du Nord, Royal Dutch-Shell‡, formerly Petrofina Belgian Group) now A.I.O.C.§	Dunkerque	520,000	.....	.....	.....	1 Winkler-Koch	†300	†Acid	....	.....
		.....	.....	.....	.....	2 Carburol	†200	†Clay	....	.....
Vacuum Oil Co. S.A.F., Socony-Vacuum	Notre Dame de Gravenchon	250,000	.....	360,000	Venezuela Middle East	Clean cycle	*320	Acid clay	115	.....
		.....	.....	.....		Kellogg	...	†Duosol	100	.....
Raffinerie de Petrole de la Gironde, Caltex	Bec D'Ambes	220,000	.....	.....	.....	Dubbs	†300	....	....	.....
		.....	.....	.....	.....	Cross	†280	....	....	.....
						Reforming	150	....	....	.....
Cie. Industrial le des Petroles, Socony-Vacuum	Frontignan	210,000	.....	70,000	.....	Clean cycle Reforming	†350	Acid-clay*	....	Wax
Pechelbronn-Est. Ste. d'Exploitation Miniere, Pechelbronn	Merckwiller	140,000	.....	50,000	Pechelbronn (Indigenous)	.....	.....	Acid-clay*	....	Asphalt
Pechelbronn Ouest S.A., Pechelbronn¶	Donges	180,000	.....	180,000	Gulf Coast	Winkler-Koch combine	400	....	....	.....
Consommateurs de Petrole, main participants are large consumers of oil products¶	Donges	140,000	.....	140,000	Gulf Coast	.....	.....	....	(*)	.....
		8,100,000	1,800,000	6,680,000						

*Operating. †Destroyed or damaged. ‡Berre and Jupiter have amalgamated their refinery installations, which will be operated jointly. §The Societe Generale des Huiles de Petroles, French subsidiary of Anglo-Iranian Oil Co., has purchased what remains of the Dunkerque refinery (greatly damaged during the war) and intends to build a new 25,000-bbl.-daily refinery on the site. To be built in 1950. ¶Pechelbronn-Ouest and Consommateurs recently formed a joint subsidiary "Raffineries Francaises des Petroles de l'Atlantique" for the joint extension and operation of their two Donges refineries, which will become one 800,000-ton refinery.

Rep. Klein Predicts Tapline Abandonment

WASHINGTON.—Early abandonment of the Trans-Arabian pipe line was predicted in the House last week by Rep. Arthur G. Klein of New York, but the congressman did not disclose the basis of what he said were "good reasons" for that belief.

Klein told the House that in this country, Mexico, and South America there are untapped resources of petroleum "which dwarf the subterranean lakes of Iraq and Saudi Arabia."

"I have good reasons for believing that the whole project of building a huge pipe line from Arabia to the Mediterranean Sea, which has dislocated the American steel industry and directly led to the astounding reversal of American policy on partition of Palestine, will be scrapped soon," he said.

"The fact is that oil from the Near East is going to flow whether or not Aramco's exploitation there is backed by American armed might. The fact is that in case of actual war we could not hold those fields—they would be captured or destroyed in the first hours' fighting. The fact is that we have in the Western Hemisphere all the oil reserves we can use, in war or in peace."

The only "apparent reason" for not developing Mexican oil fields is that American oil companies cannot exploit that oil "with the same reckless abandon which once made Tampico a wild and riotous town—that, and the desire to hold up prices," Klein charged.

Adams Says Phillips Dealing With Pemex

HOUSTON.—Reports that Phillips Petroleum Co., among other operators, is negotiating with Petroleos Mexicanos to undertake operations in Mexico was confirmed last week by K. S. Adams, Phillips president.

Adams, in Houston on an inspection trip, said increased imports from the Middle East and South America is the key toward balancing oil supply and demand in the United States. Phillips Venezuelan Oil Co. is now producing about 3,000 bbl. daily, and Phillips is entering the Middle East through American Independent Oil Co., in which it has a 20 per cent interest.

There has been considerable interest in Texas oil circles on the likelihood that several United States companies will enter Mexico through various drilling arrangements. It was reported several weeks ago Glenn McCarthy, Houston independent, might sign a drilling deal with Pemex. Cities Service Oil Co. recently announced a plan where it would assist Pemex in Mexican developments.

Egypt Drafts Law for Sudr, Asl Development

The Egyptian Cabinet is preparing to submit to parliament a draft law approving the concession granted to Anglo-Egyptian Oilfields, Ltd. R(oyal Dutch-Shell) for the development of the new oil fields (Sudr and Asl) in the Sinai Peninsula.

This is the area developed by Anglo-Egyptian and jointly owned by that company and Socony-Vacuum Oil Co., Inc.

If approved, this draft law would authorize the minister of commerce and industry to grant Anglo-Egyptian, with the approval of the cabinet, the right to develop the new oil fields of the Sudr region, over an area of 100 square kilometers, approximately 65 miles.

According to the law, the development would be subject to a 30-year period, with 15-year renewal option.

Another condition is that the companies involved pay the Egyptian Government 14 per cent of the value of the crude oil produced.

(For additional information about the Sinai developments, see The Oil and Gas Journal, March 11, page 60; February 12, page 60, both 1948; and December 20, 1947, page 42).

Venezuelan Production Shows February Gain

Crude-oil production in Venezuela in February averaged 1,297,256 bbl. daily, an increase of 15,808 bbl. daily over production in January, according to official figures of the ministry of fomento.

Production in western fields averaged 930,972 bbl. daily in February, compared with 917,252 in January, and output in eastern fields averaged 366,284 bbl. daily, compared with 364,196 bbl.

Gulf, Atlantic Abandon Wildcat in Nicaragua

The Nicaragua wildcat being drilled by Gulf Oil Corp. and Atlantic Refining Co. has been abandoned at 6,267 ft. However, the companies are doing geological work on Nicaragua's east coast and have not given up concession rights.

The seismograph party, which was working in Nicaragua, has been transferred to Cuba, where Gulf is conducting exploratory operations.

Little Progress Noted In Austrian Oil Dispute

Although some progress has been reported in the negotiations between Russia and the United States and Great Britain over the long-disputed Austrian oil properties, it is apparent from recent Reuters dispatches that little real progress is being made.

The latest reports from Vienna indicate that the Soviets are still unwilling to accept the United States and British proposals (which were explicit in the Potsdam agreement) to settle Russia's claims against Austrian oil properties.

Clauses dealing with refineries, oil fields, distribution, and duration of contracts have been drafted, but there has been no definite agreement. Meanwhile, the deputies of all countries concerned continue to hold meetings.

Exploratory Work in New Australian Area Planned

Extensive exploratory work is scheduled to commence soon in the Kimberleys in Western Australia by a group (no company has yet been officially formed) consisting of Standard-Vacuum Oil Co., Anglo-Iranian Oil Co., Ltd., and certain Australian zinc interests. Each is understood to hold a one-third interest, and the area to be covered consists of several thousand square miles. Exploration may be continued there for the next 5 years.

Meanwhile, an Australian Government-sponsored company has drilled at least one test well, which reached 4,200 ft., in the Kimberly River Basin, but which has been temporarily shut down.

A so-called cast deposit of soft coal, or black shale, in western Australia, stretching over an area of about 60 miles between the townships of Mingenew and Eradu, may prove to be an important source of oil, according to H. B. Johnson, minister of interior, who recently returned from a tour of that area.

Kuwait Production Now At 100,000 Bbl. Daily

Kuwait's crude-oil production is now approximately 100,000 bbl. a day, and by the end of this year it is expected that the output will be considerably beyond the 160,000-bbl. daily goal which was announced several months ago.

Inadequate loading facilities at Fahaheel and an insufficient number of tankers result in a slight fluctuation of the daily production.

Meanwhile, Kuwait Oil Co., Ltd., which is jointly owned by Gulf Oil Corp. and Anglo-Iranian Oil Co., Ltd., has a large-scale housing program under way.

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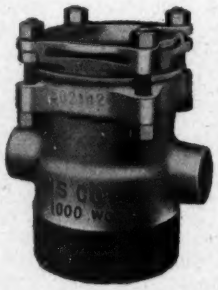

NATIONAL CASING HEAD TYPE KHL-1

The National KHL-1 Casing Head is a simple unit designed to seal off a single string of casing in wells of medium depths and pressures where an independent tubing head is used to support the tubing.

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NATIONAL BLUE PRODUCTS

LINE OF OIL FIELD EQUIPMENT ★ FOR PRODUCTION

New 2-Month Texas Allowable Provides for Little Change

AUSTIN.—Texas' new 2-month allowable order for May and June leaves the state's production level virtually unchanged except for East Texas field, which was cut back nearly 10,000 bbl. daily during May.

The possibility that the allowables will be reduced through revisions in maximum efficient production rates early in May still faces the industry. Hearings at which engineering data are taken on new MER's are continuing before the Texas Railroad Commission here, the latest being that for West Texas which was held April 15-16.

One of the commissioners, W. J. Murray, Jr., said results of hearings on other areas earlier in April indicated a downward trend in MER's, but whether this will be balanced by increases in other areas, such as West Texas, is a question. He emphasized there have been no findings as yet by the commission on new MER's.

The May-June allowable order keeps East Texas field on a 21-day producing schedule for the 31-day month of May, thus providing a reduction in field's output of 9,825 bbl. daily to 306,981 bbl. daily.

Total net allowable for May was set at 2,608,196 bbl. daily, with actual production figured at 2,456,421 bbl. daily considering underproduction of 5.8 per cent, or 151,275 bbl. daily. This production estimate of 2,456,421 bbl. daily is above the Bureau of Mines' forecast of demand of 4,450,000 bbl. daily. In addition, Texas is expected to produce 229,402 bbl. daily of natural gasoline and distillate, raising the state's total liquid-hydrocarbon output to 2,685,823 bbl. daily.

More Output in May

For June, East Texas field will remain on a 21-day schedule during this 30-day month. As a result, the reduction in production provided during May will be restored, lifting the field's cutput to 316,806 bbl. daily.

The reduction in East Texas production in May was taken in view of engineering reports showing a decline in bottom-hole pressure of 2,31 psi. during March, when the field was on a 22-day producing schedule. East Texas pressure April 1 averaged 1,009.14 psi. Salt-water injections were increased 7,694 bbl. daily during February to average 516,551 bbl. daily.

The commission by its order refused the request of H. P. Nichols, of the East Texas Oil Association, that the field be cut to 20 days for May and June. This was opposed by Paul McDermott, Fort Worth and Clare Bryson, McMurray Refining Co. Bryson said the field's pressure had been increased nearly 8 psi. in the last 39 months while 400,000,000 bbl. were being produced.

The commission indicated it would rescind an old rule governing penetration of pay in East Texas field. This rule allowed wells completed at or below —3,300 datum a 4-ft. penetration of the pay, and wells above —3,300, penetration of two-thirds of the distance from the top of the pay to the water level. It was contended by operators that this regulation is obsolete and interferes with effective completion of wells.

NEW CHEMICAL PLANT NOW IN FULL PRODUCTION

Fractionating towers on ethylene oxide and ethylene glycol unit of the new Port Neches plant of Jefferson Chemical Co., Inc., which has just gone into full commercial production of ethylene derivatives. Located on a 1,100-acre tract on the Neches River, the plant operates largely on refinery gases from The Texas Co.'s 170,000-bbl. Port Arthur refinery. Jefferson Chemical was formed in November 1944 by The Texas Co. and American Cynamid Co. The plant manufactures ethylene glycol, ethylene oxide, ethylene dichloride, and other products

C. E. Terrill Named Gas Short Course Chairman

C. E. Terrill, Southern Natural Gas Co., Birmingham, was named chairman of the 1949 Southwestern Gas Measurement Short Course at the 1948 short course held April 12-14 at the University of Oklahoma, Norman, Okla.

W. H. Carson, dean of the university's college of engineering, was re-elected chairman of the executive committee and the local arrangements committee.

Other committee chairmen named include W. H. Woods, Gulf Oil Corp., Houston, program; James L. Griffin, Northern Natural Gas Co., Omaha, publications; George E. Greiner, Phillips Petroleum Co., Bartlesville, practical methods; Miss Kate A. Niblack, Oklahoma Utilities Association, Oklahoma City, registrations and publicity.

Joseph Bowes, president of Oklahoma Natural Gas Co., was principal speaker at the 3-day meeting. Sherwood Tucker, Lone Star Gas Co., Dallas, won first prize in a contest to determine the best paper prepared on the value of the short course.

Union Oil Co.'s Annual Report Is Televised

To present a more comprehensive and graphic method of announcing its annual report to stockholders, Union Oil Co. of California last week televised its 12-month statement over nine television stations is as many cities.

Reese H. Taylor, Union's president, explained that the company hoped to demonstrate for the first time the practicability of carrying its story to the general public, as well as its own shareholders, employees, and customers.

WASHINGTON WATCHING

BY BERTRAM F. LINZ

Shades of Janus

WASHINGTON.—Election-year jitters may kill the Moore-Rizley bill for revision of the Natural Gas Act.

The terms of 32 senators expire next January, and while a few have announced they will not run for reelection most have convinced themselves they are vitally needed in Washington and are hoping their constituents will agree.

Weighing their chances for reelection, a good many senators have recognized they cannot afford to be tagged as "utilities men" in areas where it is still considered good economics to lead the worn-out cow to the railroad track, and while privately they agree that revision of the Natural Gas Act is highly desirable, in most states there are more gas consumers than gas producers.

In its simplest terms the situation merely is that the gas bill can be passed next year if it isn't passed now, but Senate seats must be won this year or not at all.

It never was visualized that the bill would get through the Senate by anything like a unanimous vote, and if preliminary talks indicate the going will be tough it may be sidetracked. The terms of 18 Republicans expire next year and some of them are going to have trouble getting their licenses renewed, even under the best of circumstances.

Another OPA?

WITH the European Recovery Program and tax reduction out of the way, the administration drive to reimpose price and materials controls is being steamed up and shortly will be loosed against the wall of congressional opposition.

Aside from the military-preparedness program, this is the only major issue which now is expected to be dealt with in the short time remaining before adjournment of the session. It probably will be the subject of another mesage by President Truman as soon as the question of the draft and universal military training is settled.

The plan to reimpose a considerable part of the wartime controls originally was proposed last fall as a complement to the foreign-aid program, but was ignored by Congress. President Truman, however, is a stubborn man, and while the issue was more or less soft-pedaled during consideration of ERP, with the quick passage of which administration wanted no interference, has by no means abandoned it as a weapon for fighting inflation.

With the President's Council of Economic Advisers recently renewing their recommendation for "selective standby" controls, the springboard for a new drive was set. Barring a sudden change in the economic atmosphere, however, it is highly unlikely that Congress will even consider control legislation this year.

The greatest handicap to the President's control program is its support by leftist and communist groups, which has led many in Congress who otherwise might consider it seriously to shun it as the first step toward a planned economy in which the Government would permanently control production and distribution.

For a New Oil Probe

REPUBLICAN leaders on the House side of the Capitol have been interested by Rep. Charles A. Wolverton of New Jersey in his suggestion that a joint Senate-House committee be created to take over the problem of oil.

Although it is too late in the session for any such group to undertake anything constructive, some thought is being given to setting it up with instructions to report at the opening of the next session. Big attraction would be a carfare-and-rolls allowance which would enable members to do traveling research this summer.

In the light of the lengthy, tedious investigations of oil made in the last 6 months by at least 15 committees, his own included, there is considerable merit in Wolverton's suggestion, and company and government officials would save a lot of time and the taxpayers' money might be conserved, only it is doubtful whether it would work out that way.

Currently, this is primarily because oil has a habit of creeping into the spotlight nearly every time major legislation hits the stage, and the foreign affairs, appropriations, and armed services committees, to mention just a few, are not likely to turn over any part of their work to another group.

Only in the field of straight oil legislation would a joint committee carry weight, and in that field, until the recent past, Wolverton's own committee was the acknowledged leader of the House. Right now the committee is in the midst of an exhaustive investigation, but there is no indication it is developing any conclusions which will be possible of legislation in the short time of the session which remains.

More Ocean Oil

GRAVELY concerned over oil supply for the increased military forces now planned, defense officials are urging Secretary of the Interior J. A. Krug to get behind a move to increase production from offshore areas.

Krug is being asked to offer inducements to holders of idle leases in the California tidelands to undertake production and to urge the Gulf states to go all-out in leasing their offshore oil lands.

The plan under consideration would involve consultation with the attorney general to get the necessary legal authority. With that, Krug would be able to assure the holders of California leases that if they get into production they will be fully protected in the event Congress does not restore the tidelands to the state. Similar assurance that the provisions of state leases would be accepted in the event the lands are finally held to be federal property would be given to operators in the Gulf states which have been singled out as next for attack in the administration's plan to get possession of the offshore lands.

The whole question of oil development on the federal lands reportedly will be dropped in the lap of the National Petroleum Council in the near future, with a request from Interior that a committee on public lands be set up to consider how maximum development can best be quickly achieved.

The heavy pressure for new oil exerted by the European recovery program, rearmament, and expanding civilian consumption may also lead to consideration of subsidies as well as loans to those who are willing to start the new synthetic-fuels industry, as proposed in the latest draft of legislation written by Chairman Charles A. Wolverton of the House interstate commerce committee.

Not So Free, Anymore

IF anybody in the oil industry thinks he is again living in the gay nineties era of "free enterprise" in which the Government has no interest in him other than to see that he kicks through with his taxes, this may serve to change his mind.

Coming to Washington to talk about exports, he will have to go to the Office of International Trade and maybe the Department of State; if he wants to complain about a lack of

steel he goes to the Office of Domestic Commerce and perhaps the new Office of Industry Cooperation or, if he's talking containers, the Office of Materials Distribution.

To talk about synthetic fuels he will go first to the Bureau of Mines and then maybe to the Reconstruction Finance Corp. to see about a loan for a new plant, and of course he can take a lot of other problems to the bureau, the Oil and Gas Division, the Geological Survey, or the Bureau of Land Management.

If he wants to sell to the Government he can talk to the Armed Services Petroleum Board or the Bureau of Federal Supply, and if his business involves oil in Europe he can trot over to the now forming Economic Cooperation Administration. If he has something that will aid in the destruction of an enemy or improve our military efficiency, he will find interested hearers in a number of agencies in the Army, Navy, and Air Corps, or he might go to the Munitions Board or the National Resources Security Board.

Getting into the field of chemicals, the Bureau of Agricultural and Industrial Chemistry might be his port of call. If he wants to start something, he may do it at the Department of Justice. Labor problems might take him to the Department of Labor or the National Labor Relations Board. Questions of radio for exploratory purposes would involve a visit to the Federal Communications Commission, while if it's transportation he must talk to the Interstate Commerce Commission or Maritime Commission.

That is far from a complete list, but its enough to show that there are few activities in which the Government isn't interested.

And, of course, if an oilman feels he is getting the run-around, he can always write to the President or go to the Capitol, where one or another of nearly a score of committees which like to dabble in oil will greet him with open arms.

Immediate Tidelands Leasing System Is Asked; Quitclaim Bill Opposed

WASHINGTON.—Administration officials told Congress over the week-end that discovery of "indications" of possible oil-bearing salt domes in the Gulf of Mexico make imperative quick action on legislation setting up a leasing system for oil deposits under the tidelands and Continental Shelf.

In a letter signed by Defense Secretary James V. Forrestal, Attorney General Tom C. Clark, and Interior Secretary J. A. Krug, the chairmen of the House and Senate public lands committee were urged to enact legislation to provide for the development, exploitation, and conservation of the underwater resources.

The discovery of a potential source of oil also was advanced as a potent reason why Congress should not pass the tidelands quitclaim legislation, already approved by a House judiciary committee and up for consideration this week before the Senate judiciary committee.

A joint statement by the Office of Naval Research and Geological Survey disclosed that Tidelands Exploration Co. of Houston found the indications of the salt domes lying from 20 to 75 miles offshore between Sabine Pass, Tex., and Grand Cheniere, La., during the course of gravity studies under a contract with the survey.

As translated for the congressional committee chairmen, the three cabinet members hailed the discovery as a "possibility that structures exist in this region comparable to those that have constituted reservoirs of petroleum inland from the Gulf."

The Continental Shelf was tied in with the tidelands, it was explained, because of the effort of Louisiana to extend its boundary 27 miles into the Gulf by a 1938 statute and a similar statute in Texas in 1941 and the move last year to run the Texas boundary to the outer edge of the Continental Shelf.

Both the formal statement and the letter emphasized that more detailed exploration will be needed to determine whether oil exists in the area in sufficient quantity to warrant exploitation, and the statement disclosed the discovery was incidental to gravimetric surveys made in studying the structure of the Shelf with the hope of throwing light on the entire structure of the outer part of the earth's crust.

The two agencies, however, saw in the Continental Shelf development an answer to critics of government research, declaring the discovery "emphasizes the economic practicability of governmental agencies conducting basic research and reconnaissance surveys in new or relatively inaccessible areas in order to point the way for the development and exploitation of the economic possibilities of such areas."

Program for I.P.A.A. Meeting Announced

"Pending Oil Legislation in the Present Congress," a talk by Russell B. Brown, general counsel for the Independent Petroleum Association of America, will highlight the opening general session of the midyear meeting of I.P.A.A. directors in Wichita April 26.

John W. Boatright, chief economist of Standard Oil Co. (Ind.), will address the directors on "The Accomplishments of the Petroleum Industry Postwar" at the first luncheon of the 2-day meeting.

The afternoon meeting of the opening day will be devoted to a secondary-recovery forum. J. P. Jones, director of production of the Pennsylvania Grade Crude Oil Association, will speak on "Research in Secondary Recovery," following which a panel discussion on the economics of secondary recovery will be presented.

The panel will be led by R. C. Earlougher, Earlougher Engineering Co., Tulsa. Members of the panel will be Don T. Andrus, Bradford, Ohio; W. B. Berwald, Findlay, Ohio; J. H. Cable, Wichita Falls, Tex.; Meyer H. Dubrow, Ponca City, Okla.; W. A. Heath, W. L. Horner, Donald P. Oak, L. A. Ogden, and Virgil S. Tilley, all of Tulsa; Z. Z. Hunter, Bartlesville, Okla.; K. B. Nowels, Ada, Okla.; and Arthur C. Simmons, Bradford, Pa.

The general session opening the second day will feature a public-relations forum, including addresses by Ralph Champlin, Ethyl Corp., chairman of the American Petroleum Institute Oil Industry Information Committee; Frank B. Taylor, I.P.A.A. public-relations director; and Guy I. Warren, Renwar Oil Corp., Corpus Christi.

The afternoon meeting will be devoted to a materials forum. Minor S. Jameson, I.P.A.A. economist, will discuss results of the National Petroleum Council's steel survey.

Buchanan Named FPC Member; Opposition Seen

WASHINGTON.—Thomas Chalmers Buchanan, Pennsylvania lawyer, was nominated by President Truman last week to be the fifth member of the Federal Power Commission for a term to expire June 22, 1952.

Buchanan, one-time member of the Pennsylvania Utilities Commission, was named to the post for which the President originally selected Burton N. Behling, director of the FPC's natural-gas investigation. Behling's name was withdrawn last month a few hours before the Senate judiciary committee was scheduled to pass on the appointment.

Confirmation of Buchanan, who is seen as more likely to side with Commissioners Olds and Draper in opposition to revision of the Natural Gas Act than with Commissioners Smith and Wimberly, who favor changes, is expected to be strongly opposed and there is some doubt whether it could be secured this session.

With Buchanan's nomination the President sent reappointment of Wimberly for another term.

Krug Tells NPC Next 18 Months To Be Critical for Oil Industry

WASHINGTON.—A solemn warning by Interior Secretary J. A. Krug that the next 12 to 18 months may be the most critical peacetime period ever experienced by the oil industry greeted members of the National Petroleum Council as they met April 15 to discuss the industry's voluntary agreement, steel requirements, and other current problems.

Working quickly, the council laid down the basic elements of the agreement to be developed under Public Law 395 and sent a call to the five districts to submit comment and suggestions within 10 days so that the industry advisory committee might be called into session around May 1.

At the same time, the council asked the department to request the attorney general to extend until June 15 those provisions of the temporary agreement which deal with motor fuel, in a move to insure that there will be no let-up in the effort to get all supplies required to points of need.

Committees Set Up

In other actions, the council set up a half-dozen committees requested by Max W. Ball, director of the Oil and Gas Division; denied his request for a committee to study trends in production, sale, installation, and use of oil-consuming equipment, and unanimously adopted a resolution of approval of the administration of the OGD and directing Chairman Walter S. Hallanan to appear before the congressional appropriation committees in support of its request for an appropriation of $225,000 for its Washington office and $175,000 for enforcement of the Connally Act for the fiscal year beginning July 1.

While the report of the committee on the voluntary agreement headed by Dr. Robert E. Wilson was adopted unanimously, it was emphasized that it merely laid down the principles to be followed—generally those of the temporary agreement adopted to meet last winter's fuel-oil shortage—and is in no sense binding, although in the event industry reaction indicated the need for major modifications which the advisory committee felt it could not accept it would be necessary either to start all over or abandon the effort to make an agreement.

If the industry committee is able to agree on definite proposals, however, it is planned to call the necessary public hearing as soon thereafter as possible.

It was stressed by Hallanan that the agreement is directed at taking care of the consumer and involves no attempt to aid any segments of the industry, such as small refiners who are unable to secure adequate crude supplies.

Reviewing the results of the temporary agreement, Dr. Wilson pointed out that production of kerosine and distillate in the 8 weeks following its adoption was 9.8 per cent over that of the preceding 8 weeks and 31.5 per cent over the corresponding period a year before.

So successful was the program that the committee recommended it be used again next fall if there then appears a probable shortage of heating oil, and that the same principles be followed in writing the new agreement to apply until March 1, 1949.

Outlining what is proposed, Wilson told the council that "in short, and stated in terms of principle, what the committee has in mind is a continuance, under the sanction of Public Law 395 and the regulations thereunder, of the present general type of organization and program designed to deal with such shortage situations as may arise."

Discussing the OGD's request for funds, Ball told the council that a half-dozen expert oil men must be added to his staff and it is to the advantage of the industry to see that it gets them. At the same time, he warned that the industry should come up with a man who, after a few months as associate director, could take over the administration of the division and permit him to retire, as he has repeatedly said he plans to do at the earliest opportunity.

Steel Report Adopted

The council adopted the report of the steel-requirements committee headed by Russell B. Brown, emphasizing that it was to be construed as a factual report and not as the basis of a request for an allocation under the steel agreement which is being worked out by the Department of Commerce.

The Interior Department's analysis of the estimates has been completed and will shortly go to Commerce, with no indication of any criticism of the figures, which Ball believes are, if anything, on the low side.

The new committees authorized include one to study the petroleum experience of the last war and recommend such Government, Government-industry, and industry organizations, procedures, and policies as would best meet the needs of another emergency, the agenda committee's recommendation of approval carrying the comment it was made "with the hope and expectation that the results of the study will never be needed."

Other committees will deal with petroleum production and crude availability; petroleum-refining capacity; petroleum tanker transportation; storage capacity, minimum working level stocks, and nonavailable stocks of crude and products; and proposed new regulations on the disposal of government royalty oil which are under consideration in the Interior Department.

Broad Program Set For Denver Meeting

Both the international and the domestic problems of the oil industry will be highlighted in reports to be presented at the joint meeting of the American Association of Petroleum Geologists, the Society of Economic Paleontologists and Mineralogists, and the Society of Exploration Geophysicists at the Shirley-Savoy Hotel, Denver, April 26-29.

The program will be opened the evening of April 26 at 7:30 with two scheduled reports: "Mexican Oil," by Senator Antonio J. Bermudez, director of Petroleos Mexicanos; and "Prospects of Conversion of Western Coals to Synthetic Liquid Fuel," by V. F. Parry, supervising engineer of the U. S. Bureau of Mines station at Golden, Colo.

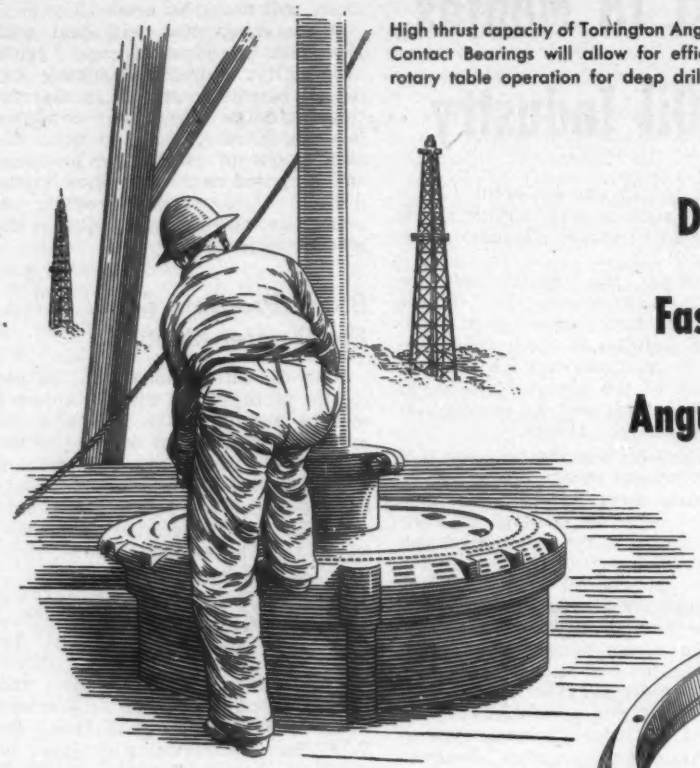
Other reports to be given include: "Oil in the Middle East," James Terry Duce, vice president, and Max Steinecke, chief geologist, of Arabian-American Oil Co.; papers on the occurrence of oil in the Arbuckle and Ellenburger formations; the "Golden Trend;" the Leduc oil field of Alberta, Canada; statistics of 1947 drilling; a symposium on the Rocky Mountain region; regional and statewide papers on the stratigraphy and paleogeography of Colorado, Wyoming, Utah, Montana, and adjacent areas; coral-reef production; Permian Basin gas resources; and the oil prespects of Naval Petroleum Reserve No. 4 in northern Alaska.

Three field trips have been planned as a part of the convention, one a preconvention trip and two postconvention trips.

Privately Owned Tankers Show First-Quarter Gain

WASHINGTON.—The privately-owned American merchant fleet included 439 tanks on April 1, representing an increase of 79 in the first 3 months of this year, it was reported last week by the National Federation of American Shipping.

On the same date, the federation said, the Government held 84 tankers, of which 37 were actively operating under general agency agreements, and had in the reserve fleet nine overage and 30 war-built tankers.



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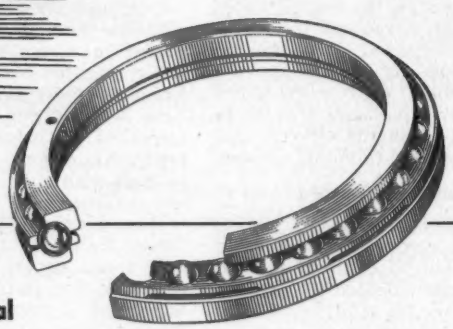

...high thrust capacity of this special Torrington Bearing helps keep rotary tables in continuous operation.

TO TAKE the high loads and speeds imposed on rotary tables by deep drilling operations, Torrington Angular Contact Bearings are *engineered* for the application. They are rigidly controlled in the hardening and grinding processes to insure precision and equalized load distribution for smooth operation. Heavier drill strings and high table speeds can be handled because of their high capacity and low friction coefficient.

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PERSONALS

Lawry Named to High Shell Production Post

E. C. LAWRY, former manager of Shell Oil Co., Inc.'s South Texas division with offices in Houston, has been promoted to Houston area production superintendent for Shell.

Lawry, whose new appointment was effective April 1, is a native of Fairfield, Me., who attended the University of Maine, majoring in chemical engineering. He began his career with Shell in 1922 at South Bend, Tex., as exploitation engineer for the company's operations in Texas and Arkansas, remaining in this position until 1925 when he became district superintendent at Smackover, Ark.

In 1928 he was transferred to Wichita Falls as district superintendent for Shell's North Texas district, and 2 years later, he moved to Dallas as district superintendent in charge of what later became part of Shell's South Texas division.

Lawry has been a resident of Houston since 1933 when he was placed in charge of production activities for the entire Texas and Louisiana Gulf Coast area. In 1936 he became manager of the newly created South Texas division, including the Texas Gulf Coast area as well as the San Antonio district, and remained in that position until his recent appointment as production superintendent for the Houston area.

In his new position, Lawry will give the benefit of his years of production experience to the solution of production problems throughout the area. He has already taken over his new responsibilities at the Shell Building in Houston.

C. J. Tighe has joined Stanolind Oil & Gas Co. as field project engineer in charge of the construction of the Stanolind gasoline plant near Ulysses, Kans.

L. A. Cranson, executive vice president and a director of Honolulu Oil Corp., has been elected president of Oil Producers Agency of California to succeed **W. C. Whaley,** vice president and manager of Barnsdall Oil Co.'s California operations.

A. J. Morris, formerly in the Philadelphia office, has been made pipeline superintendent for Venezuelan Atlantic Refining Co. at Caracas.

P. L. Keller, district geologist at Evansville, Ind., for Great Lakes Carbon Co., has resigned and will move to Denver, Colo.

C. B. Schwartz, Shreveport, La., has resigned as assistant division geologist for Carter Oil Co., to become vice president of Cook Drilling Co. He will be located at Fort Worth.

L. M. Bussert, assistant manager of the marketing department for Standard Oil Co. of California, has been appointed manager of operations for that department. He succeeds **P. L. Fahrney,** recently elected to a vice presidency of the company.

Miss Alice Quesenbery, geologist for the past 12 years with Cities Service Oil Co., has become associated with Denver Sample Log Service, a newly established sample log service for Colorado, Utah, and northern New Mexico. Miss Quesenbery is a 1936 graduate of the University of Oklahoma and before moving to Denver was secretary-treasurer and director of the Kansas Geological Society.

Robert B. Curran, a director and vice president in charge of production for Carter Oil Co., has resigned to become head of all oil development and producing operations for W. H. Barber Co., Minneapolis, Minn. He will make his headquarters at Casper, Wyo. Only last month Curran was named production head for Carter succeeding **J. R. McWilliams,** who became executive vice president. Previous to his last appointment with Carter, Curran was manager of the company's northwest division. The Barber company recently acquired extensive oil producing properties in the Rocky Mountain region.

A. G. Schei, assistant treasurer for Shell Oil Co., Inc., in the San Francisco offices, headquarters for the Pacific Coast territory, has been named treasurer of Shell Chemical Corp. to succeed **J. W. Watson,** vice president and treasurer, retired. **C. C. Combs,** assistant secretary and assistant treasurer of Shell Union Oil Corp. in New York will replace Schei at San Francisco.

Victor L. Norman, vice president and general manager of Woolner Oil Corp., has been elected president of the California Stripper Well Association. He succeeds **Earle F. Demond. L. A. Donnelly,** vice president of Exeter Oil Co.; **Edwin P. Crail,** president of Victory Oil Co.; and **Lloyd M. Willis,** vice president of D. D. Dunlap Oil Co., were elected vice presidents. Reelected were **Thomas H. Work,** Nordon Corp., secretary-treasurer; and **Richard Fenton,** executive vice president.

Lawrence T. Haugen, formerly assistant chief for administration of the United States Navy Bureau of Ships, has been appointed construction superintendent of Stanolind Oil & Gas Co.'s manufacturing department. As a captain in the Navy, Haugen was force constructor and material officer of the North Atlantic naval task force and later was supervisor of shipbuilding in the Pittsburgh area. From 1943 to the end of the war he was the planning officer of the Pearl Harbor Navy Yard. Haugen will supervise Stanolind's plant construction program, which includes the hydrocarbon-synthesis project at Garden City, Kans., a chemical products plant at Brownsville, Tex., and six natural-gasoline and cycling plants.

D. L. Wolfe, formerly manager of the coordinating department for Stanolind Oil Purchasing Co., Tulsa, has been promoted to manager of the executive department. Other changes in the company personnel include: **P. M. Broach,** to manager of the trade and exchange section; **J. C. Mytinger** and **H. A. Weatherby,** to assistant managers of that department; **W. A. Kirkpatrick,** to assistant manager of the coordinating department; **J. T. Perkins,** to manager of the field operations department, and **D. R. Ryan** and **R. G. Bandy** to assistant managers. Field representatives or crude-

PERSONALS

oil buyers transferred from the Tulsa office were: **M. P. Moore,** to Oklahoma City; **H. C. Steele,** to Ardmore, Okla.; and **J. R. Mason,** to Wichita, Kans. **G. C. Getgood** has been named supervisor in charge of the division order department, and **P. W. Perryman,** in charge of the contract department. Previously these departments were combined in one.

Sherril Williams, of Amarillo, Tex., has been sent as scout for Cities Service Oil Co., Bartlesville, Okla., to Calgary to make a survey of the Alberta oil lands and developments.

J. B. Holstead, formerly in Florida with Sun Oil Co., has joined the company's Midland, Tex., office as land man.

Len Parker, formerly with Tropical Oil Co. in Bogota, has been named resident engineer for Superior Oil Co. with headquarters in Caracas.

L. O. Vogelsang, general manager of Rio Grande Valley Gas Co., Brownsville, Tex., for the past 2 years, has been elected vice president of the company. **W. H. Meredith,** assistant secretary and assistant treasurer of the company, has been named treasurer.

Granville Tierney, formerly land man for Amerada Petroleum Corp. in Jackson, Miss., has been named special assistant to **H. E. Zoller,** president of Derby Oil Co. at Wichita.

D. R. Johnson, superintendent of the Ponca City, Okla., refinery for Continental Oil Co., has been named to the company's newly established position of southern region refinery superintendent. He will supervise operations of plants at Ponca City, Lake Charles, La.; Wichita Falls, Tex.; and Artesia, N. M. He will make his headquarters in Ponca City

D. R. JOHNSON

J. E. FENEX

J. E. Fenex, superintendent of Continental Oil Co.'s Lake Charles refinery, has been named the western region refinery superintendent for the company with headquarters in Denver. He will supervise operations of plants at Denver; Glenrock, Wyo.; Farmington, N. M.; and the new $8,500,000 refinery now under construction by Continental at Billings, Mont.

L. W. Vickery, assistant superintendent since 1943 at the Ponca City refinery, succeeds Johnson as superintendent there. **H. R. Wall,** assistant superintendent of the Lake Charles refinery since 1942, succeeds Fenex as superintendent of the Lake Charles plant. **H. G. Osborn,** vice president for Continental in charge of manufacturing, will supervise the newly created positions of regional superintendents.

Norman Woodruff, engineer with the Texas Railroad Commission, has been transferred from the Austin office to the Midland, Tex., office, and **James A. Hall, Jr.,** has been transferred from Midland to Austin. **Everett L. Smith** has been placed in charge as district engineer of Commission District 8 in West Texas.

R. P. Huggins, general manager of Western Gulf Oil Co., has been elected vice president of that company.

Carl Smith, of the production department of Gulf Oil Corp. in the Tonkawa field of Kay and Noble counties, Oklahoma, for the past 10 years, has retired.

Lt. Elmer T. Haines, a member of the army engineers section in Korea and formerly construction foreman for Black, Sivalls & Bryson, Inc., Kansas City, Mo., and prior to that superintendent for J. Arthur S. Wright, Inc., Oklahoma City, has been named to the engineering section of the recently established Pusan petroleum terminal at Seoul, Korea. Haines aided in designing building plans for the terminal, which has been established as a central point for receiving and distributing petroleum products arriving from the United States.

Dr. Gustav Egloff, Universal Oil Products Co., center of second row, was principal speaker at the April meeting of Houston Nomads, discussing technical and scientific developments now taking place in the oil industry. Guests at the meeting are shown here with Egloff. Front row: P. Pollard, Shell, Colombia; Mont Land, Tretolite Co., Venezuela; James Bradbury, Gulf Oil Corp. (retired), Houston; and Glen Byers, Shell Oil Co., Inc., Houston. Second row: J. D. Bryan, Terminal Drilling Co., Los Angeles; J. Brittain, N. V. de Bataafsche Petroleum Maatschappij; Roy Walling, Mene Grande Oil Co., Venezuela; Egloff; Kraus Earhart, The Texas Co., Houston; E. L. Gordon, Richmond Exploration Co., Venezuela. Back row: E. E. Eager, Shell, Venezuela; J. Facer, Shell, Venezuela; A. B. Patterson, Cole Drilling Co., Venezuela; R. Davila, Venezuelan consul in Houston; and G. C. P. Gifford, Kuwait Oil Co.

G. W. Gayle, scout for Humble Oil & Refining Co., has been transferred from Midland to San Angelo, Tex.

E. B. Roudebush, Central Oklahoma scout for Gulf Oil Corp., has been promoted to the land department at Oklahoma City. **Herbert Officer** has been moved to the production department to succeed Roudebush.

O. J. Cook, purchasing agent for Texas Petroleum Co. in Caracas, Venezuela, has returned to Caracas after a 3-month visit to the United States.

R. E. Gullidge, formerly with Colombian Petroleum Co. at Cucuta, Colombia, has been named materials supervisor in Caracas for Texas Petroleum Co.

Albert E. Makoski, assistant employe relations manager at the Baltimore refinery for Esso Standard Oil Co., has been made technical assistant to **Charles A. Brown,** superintendent of the Charleston refinery.

Charles R. Haag, assistant head of the operations analysis department for Bayway refinery of Esso Standard Oil Co., has been named head of that department to succeed **Dwight F. Eaton.**

W. E. Dougherty, assistant division geologist in Midland, Tex., for the West Texas division of Humble Oil & Refining Co., has been transferred to Corpus Christi as assistant division geologist in that area.

R. L. Denton, scout for Magnolia Pipe Line Co., and **R. L. McCormick,** division safety supervisor for Magnolia Petroleum Co. and Magnolia Pipe Line Co., in West Texas, have been named representatives of the crude-oil purchases and sales department of the company for all territory west of Dallas.

Richard W. Burnett, oil operator of Gladewater, Tex., has purchased the Dallas baseball club at a reported price of more than $500,000.

William Henry Twenhofel, retired chairman of the department of geology of the University of Wisconsin, and widely known authority on sedimentation, was recently made an honorary member of the Tulsa Geological Society.

Douglas G. Tomkins, of Summit, N. J., has been appointed treasurer of the Standard Oil Development Co. to succeed **Herbert P. Schoeck. Dr. Amiot P. Hewlett,** of Madison, N. J., has been named manager of general administration for Standard Oil Development.

Robert Charles Meyer, University of Alberta graduate, and **Daniel Everett Nisley,** Colorado School of Mines graduate, geologists, will join Hudson's Bay Oil & Gas Co., Ltd., operating medium in Canada of Continental Oil Co., Ponca City, Okla. **L. J. Richards,** geophysicist for Continental at Ponca City, will make his headquarters with Hudson's Bay at Calgary. The expansion of the company's staff is in preparation for a large-scale exploration program in Alberta. **Earl O. Abbott,** geologist, is in charge of Canadian operations for the company.

SHIFTS—

William D. Lewis, geologist, General Petroleum Corp., Los Angeles to Bakersfield, Calif.; **Bill Glasscock,** superintendent, Petroleum Products Refining & Producing Co., Midland, Tex., to Prewitt, N. M.; **Albert R. Greer,** engineer, Anderson Prichard Oil Corp., Hobbs, N. W., to Oklahoma City; **Claude L. Jones,** foreman, Shell Oil Co., Inc., Monroe, La., to Wichita Falls, Tex.; **Laurence Bonner,** engineer, California Co., Washington, Miss., to Rangely, Colo.

D. G. Herring, Jr., geologist, The Texas Co., Jackson to West Jackson, Miss.; **D. F. Dial, Jr.,** engineer, Pure Oil Co., Tulsa, to Houston, Tex.; **George M. Dorwart,** engineer, Union Oil Co. of California, Santa Paula to Whittier, Calif.; **Kermit V. Stephenson,** foreman, Amerada Petroleum Corp., Eunice to Monument, N. M.; **E. D. Rhea,** superintendent, Wheless Drilling Co., Kaufman, Tex., to Athens, La.

Robert F. Smith, engineer, Shell Oil Co., Inc., Houston, Tex., to Tulsa; **M. E. Mitchell, Jr.,** engineer, Humble Oil & Refining Co., Kingsville to Encino, Tex.; **Robert L. Robinson,** engineer, Union Oil Co. of California, Cut Bank, Mont., to Hutchinson, Kans.; **E. L. Smart,** superintendent, Stanolind Oil & Gas Co., Altus to Shattuck, Okla.; **Max E. Riley,** engineer, Sunray Oil Corp., Norman to Oklahoma City.

Herbert G. Officer, engineer, Gulf Oil Corp., Tulsa to Oklahoma City; **Ben E. Mosher,** superintendent, Talco Pipe Line Co., Talco to Carthage, Tex.; **C. H. Gee,** engineer, La Gloria Corp., Corpus Christi, Tex., to Shreveport, La.; **N. E. Wisdom,** engineer, Hunt Oil Co., Palestine, Tex., to Homer, La.; **George P. Zebal,** geologist, California Co., New Orleans to Lake Arthur, La.; **N. J. Gooch,** foreman, Sunray Oil Co., Madison to Bushton, Kans.

E. W. Fort, engineer, Shell Oil Co., Inc., Rolla, Mo., to New Orleans, La.; **George Kelso,** engineer, Houdry Process Corp., Marcus Hook to Philadelphia, Pa.; **O. C. Ingersoll,** foreman, The Texas Co., Rangely to Hamilton, Colo.; **Norman E. Maxwell, Jr.,** engineer, Cities Service Oil Co., Rangely, Colo., to Laramie, Wyo.; **Marion E. Parrack,** foreman, Duwe & Farris Drilling Co., Hoisington to Pawnee Rock, Kans.

DEATHS

James N. Clifton, 82, retired since 1932 from Gulf Oil Corp. as foreman in charge of inspecting stills, died April 11 in Fort Worth.

Albert E. Baumann, 54, service engineer for Republic Flow Meters Co., Chicago, died April 12 in Mount Vernon, N. Y.

Gaines T. Wallace, Texas oil operator who had lived in Houston since 1905, died April 14 in Houston.

Allan P. Patrick, 99, Alberta oil pioneer and a former director of Rocky Mountain Oil Co., died recently in Calgary.

G. J. Wyatt, 83, former driller at Corsicana, Tex., and in the Spindletop field at Beaumont, died April 14 in Mesquite, Tex.

G. C. Barkley, 63, oil operator who once owned extensive holdings at Cisco and Ranger, Tex., died April 10 in Abilene.

Dr. Alfred C. Lane, 85, former president of the Geological Society of America, died April 16 in Cambridge, Mass.

J. Reagan McCrary, Texas oil operator, died April 9 in Calvert, Tex.

Henry J. Logan, 54, superintendent of machine shops for Hughes Tool Co., died April 16 in Houston.

H. H. Hancock, 60, early-day Oklahoma oil driller, died April 18 in Tulsa.

W. H. Tabor, 87, Caldwell County, Texas., oil operator, died recently in Lockhart, Tex.

Prospective Acreage

as a measure of

Discovery Expectancy

IS there any method for estimating the relative quantity of oil which an individual company may reasonably expect to find in the future?

The present study, through a review of certain aspects of oil exploration and an analysis of discovery statistics, attempts to answer this question and apply the solution to a group of 25 oil companies.

The basic unit employed in the solution is the undeveloped or prospective oil acre. The discussion is confined to the domestic industry.

by John S. Herold*

COMMONLY referred to in oil-company annual reports as "undeveloped acreage," the term "prospective acreage" more clearly reflects the general status of such acreage. While loosely used, it is believed that undeveloped acreage represents a company's inventory of leases on which no producing wells have been drilled and on which lease rentals are still paid. Developed or producing properties, on the other hand, are probably those leases, which, irrespective of size or the degree of development, are held in force without the necessity for lease-rental payments.

The Nature of Oil Exploration

The search for and discovery of oil is at best a hazardous undertaking in which chance plays a leading part. The element of chance provides a basis, though imperfect, for estimating future results with a semblance of reasonable probability. This would not be possible if the discovery of oil was essentially the result of special knowledge, tools, and skill possessed in widely varying degree by oil operators.

For the vast majority of oil companies and enlightened individual operators the selection and exploration of prospective land proceeds along broad, well-defined lines which conform to generally accepted geological concepts regarding the type of environment favorable to oil accumulation. The tools used in the search for this environment such as the seismograph, gravity meter, core drill, etc., are likewise available to all.

No company or individual has a monopoly on the essential knowledge or tools necessary for acquiring leases or finding oil. These are available to all. Only in the application of knowledge and tools do some companies demonstrate a skill greater than that of others. However, even in the most capably managed companies, although the element of skill is a leading factor in the initial search for and selection of favorable lands, it becomes of secondary importance in the final step of actual drilling. Here, because of the variable occurrence of oil even under the most favorable-appearing conditions, chance or luck is the deciding factor.

The great abundance of prospective oil land in this country makes it practically impossible for any one company or group of companies to monopolize this land, consequently, prospective lands are generally widely distributed among many companies and individuals, so that the exploratory drilling operations of each company, even when individually financed, are of mutual benefit to other companies.

Thus "X" company, drilling a well on a lease which is located among others of diverse ownership, proves or condemns not only its own lease, but frequently also the adjacent leases of others. This aspect of the business relieves many moderately financed companies of the obligation to explore all of their prospective land. It therefore enables them to carry substantial reserves of acreage, the value of which may eventually be established in varying degree by the operations of other companies exploring nearby.

More important, however, than the sharing of information is the common sharing of new crude-oil discoveries. The extent of this process is evident by referring to Table 1.

Sharing in the rewards of new discoveries is a characteristic of the industry, and only infrequently is a company fortunate enough to hold the lion's share. When it does, a compensating lack of good luck often occurs elsewhere, as has been suggested in the notes footing Table 1.

We are all prone to speculate on discovery in terms of these rare events. If, however, we adjust our thinking to a level of probability, average future discovery results will be seen as a preponderance of small discoveries, the sum total of which will satisfy our dreams of a bonanza. The reserves of a majority of companies have grown large in this manner.

Some companies have also expanded reserves through merger with other companies. These are the exceptions, and as such they prove the rule, for frequently their failure to find new reserves through exploratory processes, even though active and well financed, can be explained by their subnormal ownership in prospective acreage.

Other companies are floundering in a morass of relatively extensive acreage unwisely concentrated in large blocks. This element of concentration effectively deprives them of the advantages to be gained from the drilling operations of other companies and places on their own organization the full burden of exploration.

In addition to the functioning of exploration as already outlined, its mutual aspect, involving the influence of companies of varying oil-finding

*Petroleum consultant, Greenwich, Conn.

TABLE 1—NUMBER OF OPERATING COMPANIES OR LEASE OWNERS IN EACH OF 10 IMPORTANT OIL FIELDS

Field and state—	Approximate No. of companies	Productive acres	Approximate ultimate oil reserve, bbl.
Magnolia, Arkansas	11	4,000	100,000,000
Louden,* Illinois	55	21,000	180,000,000
El Dorado, Kansas	32	21,000	225,000,000
Heidelberg, Mississippi	33	4,500	100,000,000
Monument, New Mexico	34	37,000	175,000,000
Oklahoma City, Oklahoma	56	15,000	700,000,000
Conroe,† Texas	43	18,000	500,000,000
East Texas, Texas	780	136,000	5,000,000,000
Slaughter,‡ Texas	49	70,000	500,000,000
Yates,¶ Texas	33	20,000	650,000,000

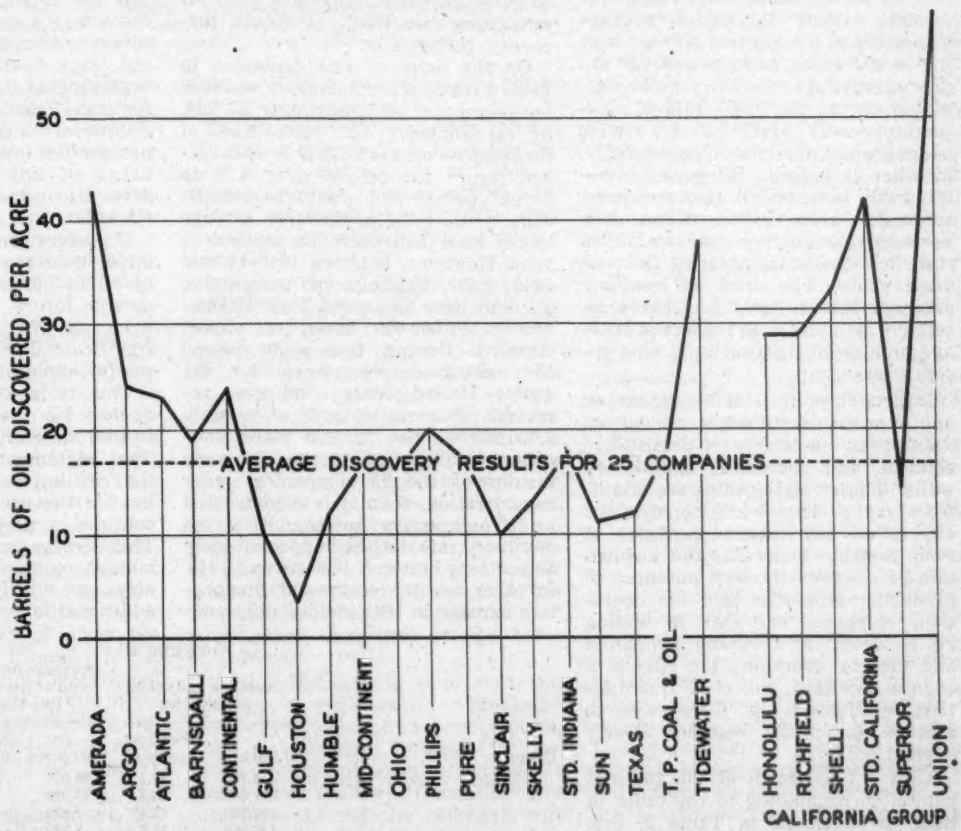
*Carter Oil Co. owns about 70 per cent of reserve. †Humble Oil & Refining Co. owns about 30 per cent of reserve. ‡Ohio Oil Co. has no reserve in this field; Humble's is negligible. ¶Ohio Oil Co. owns about 55 per cent of reserve.

TABLE 2—DATA, EMBRACING 25 OIL COMPANIES, SHOWING PROSPECTIVE OIL LANDS, ESTIMATED OIL RESERVES, ESTIMATED OIL DISCOVERIES AND OIL DISCOVERIES IN TERMS OF PROSPECTIVE LANDS FOR PERIODS INDICATED

	Initial year			Terminal year 1945						
		Prospective land	Est. oil reserve	Prospective land	Estimated oil reserve	Approx. production during	Oil discovered (1,000 bbl.)		Average prospective land during	Barrels of oil discovered per acre	
Company—	Year	(1,000 acres)	(1,000 bbl.)	(1,000 acres)	(1,000 bbl.)	period (1,000 bbl.)	During period	Average per year	period (1,000 acres)	During period	Average per year
Amerada	1941	850	222,000	1,165	372,000	73,000	223,000	44,600	1,007	221	44
Argo	1937	132	10,000	240	35,000	15,000	40,000	4,400	186	215	24
Atlantic	1941	1,350	265,000	4,469	503,000	96,000	334,000	67,000	2,909	115	23
Barnsdall	1941	676	157,000	688	180,000	43,000	66,000	13,200	682	97	19
Continental	1941	1,246	449,000	1,752	472,000	155,000	178,000	35,600	1,499	119	24
Gulf	1940	8,000	866,000	10,467	1,064,000	337,000	535,000	89,200	9,233	58	10
Honolulu	1939	220	145,000	332	150,000	51,000	56,000	8,000	276	203	29
Houston	1940	503	72,000	607	65,000	19,000	12,000	2,000	555	22	3.7
Humble	1940	8,049	1,649,000	16,513	2,079,000	480,000	910,000	152,000	12,281	74	12
Mid-Continent	1941	728	56,000	776	96,000	25,000	65,000	13,000	752	86	17
Ohio	1940	1,385	583,000	2,100	586,000	168,000	171,000	28,500	1,742	98	16
Phillips	1940	1,964	297,000	4,067	507,000	158,000	368,000	61,300	3,015	122	20
Pure	1941	1,328	346,000	2,852	425,000	136,000	215,000	43,000	2,090	103	17
Richfield	1940	168	128,000	413	124,000	44,000	40,000	6,600	290	138	29
Shell	1941	2,148	740,000	3,524	887,000	325,000	472,000	94,400	2,836	166	33
Sinclair	1940	3,000	300,000	5,100	381,000	162,000	243,000	40,500	4,050	60	10
Skelly	1941	959	156,000	1,732	191,000	56,000	91,000	18,200	1,345	68	13
Standard-Calif.	1940	1,152	721,000	2,869	922,000	305,000	506,000	84,300	2,010	252	42
Standard-Indiana	1940	3,041	656,000	8,336	969,000	295,000	608,000	101,300	5,688	107	18
Sun	1940	4,242	237,000	7,310	523,000	113,000	399,000	66,500	5,776	68	11
Superior	1938	637	76,000	3,500	205,000	97,000	226,000	28,200	2,068	109	14
Texas	1940	7,000	917,000	9,400	1,041,000	450,000	574,000	95,700	8,200	70	12
T. P. Coal & Oil	1940	400	52,000	400	75,000	19,000	42,000	7,000	400	105	18
Tide Water	1941	854	351,000	1,990	480,000	140,000	269,000	53,800	1,422	189	38
Union	1940	300	302,000	776	374,000	121,000	193,000	32,200	538	359	60
Total 25 companies		50,332	9,753,000	91,378	12,706,000	3,883,000	6,836,000	1,190,500	70,850	96.5	16.8

skill and the reciprocal interplay of benefits therefrom, operates as an element tending to bring the over-all discovery results of each company to a level which is roughly proportional to its quantitative ownership of prospective oil acreage.

Briefly summarizing exploration may be divided into two stages involving (1) the initial search for and selection of favorable acreage, and (2) the final testing by drilling of the acreage selected. The first stage involves the application of geological knowledge and tools in the use of which a variable degree of skill is exercised. In the second stage skill is replaced by the operation of chance or luck wherein prospects of equal apparent merit may be either dry or productive.



This element of chance, coupled with the sharing of reserves as a result of the frequent dividing of ownership of leases adjacent to new discovery wells, creates a condition wherein discovery results for a given company are not only a function of skill and exploratory activity, but to an important degree are also a function of quantitative ownership in prospective acreage.

This concept is the basis for the analysis which follows, wherein a company's quantitative ownership of prospective acreage is used as a measure of relative future discovery expectancy.

Table 2 contains the basic information relating to 25 oil companies upon which the preparation of other tables and statistical information has been based. The selection of companies was determined solely on the completeness of available data. Figures for prospective acreage and past production have been derived from pub-

lished company reports and various statistical services.

Individual company reserve figures are the author's own estimates of proved and semiproved reserves, based on a procedure whereby the physical data for each company receive comparable consideration. Therefore the resulting estimates, even if quantitatively inaccurate, reflect comparative results which are considered sufficiently accurate for the purpose of this study.

Crude-oil discoveries have been calculated by taking the difference in oil reserves at the beginning and end of the period under consideration to which have been added withdrawals during that period. This procedure fails to eliminate (1) oil acquired through the purchase of producing properties, or (2) the effect of revisions in previous estimates of proved reserves, but no allowance has been made for such discrepancies. The net effect of these discrepancies is to overstate the amount of oil actually discovered by certain companies.

Table 3 presents pertinent information on 20 companies with respect to average annual discoveries, average ownership of prospective acreage during recent years, and the average annual successful exploratory wells completed during the years 1945-46. Exploratory-well statistics for prior years are not available. Consequently, in order to indicate the probable relationship between oil discovered and successful wells drilled, it has been necessary to employ 1945 and 1946 statistics against discoveries for previous years. The order of company arrangement in Table 3 is based on relative standing with respect to average annual oil discoveries during recent years.

Inspection of this table suggests an approximate relationship among oil discoveries, ownership of prospective acreage, and successful exploratory wells. These relationships are admittedly vague. This is attributed to the effects on individual companies of such variable factors as the acquisition of reserves through purchase of producing properties and the operations of chance and skill in finding oil. However, by grouping companies and thereby averaging the effects of chance and skill, the close quantitative relationship of discoveries to acreage and wells becomes clearly evident.

Thus a breakdown of the 20 companies, corresponding to the order of their arrangement in Table 3, into five groups of four companies each yields the results shown in Table 4.

The results of Group 1 expressed as a percentage of corresponding results for each of the groups is presented in Table 5.

The foregoing tabulations indicate that oil-discovery results during recent years are as well expressed in terms of prospective acreage as they are measured by the number of successful exploratory wells drilled. This relationship of acreage to discoveries logically suggests a basis for estimating the trend of future discovery results.

TABLE 3—SHOWING THE RELATIONSHIP OF PROSPECTIVE ACREAGE AND SUCCESSFUL WILDCAT WELLS TO AVERAGE ANNUAL DISCOVERIES DURING RECENT YEARS FOR 20 OIL COMPANIES
(Order of companies based on quantitative oil discoveries)

Company—	Average annual oil discoveries		Average ownership of prospective acreage		Average annual successful wildcat wells	
	1,000 bbl.	Per cent of total	1,000 acres	Per cent of total	Wells	Per cent of total
Humble	152,000	13.1	12,281	17.8	25.5	10.6
Standard of Indiana	101,300	8.7	5,688	8.2	20.5	8.6
Texas	95,700	8.2	8,200	11.8	35.5	14.7
Shell	94,400	8.1	2,836	4.1	19.5	8.1
Gulf	89,200	7.7	9,233	13.4	12.0	5.0
Standard of California	84,300	7.2	2,010	2.9	12.5	5.2
Atlantic	67,000	5.8	2,909	4.2	9.0	3.8
Sun	66,500	5.7	5,776	8.3	14.5	6.0
Phillips	61,300	5.3	3,015	4.3	10.5	4.4
Tide Water	53,800	4.6	1,422	2.1	3.0	1.2
Amerada	44,600	3.9	1,007	1.5	5.5	2.3
Pure	43,000	3.7	2,090	3.0	17.0	7.1
Sinclair	40,500	3.5	4,050	5.8	8.5	3.5
Continental	35,600	3.0	1,499	2.2	17.0	7.1
Union	32,200	2.8	538	.8	3.5	1.4
Ohio	28,500	2.5	1,742	2.5	5.5	2.3
Superior	28,200	2.4	2,068	3.0	5.5	2.3
Skelly	18,200	1.6	1,345	1.9	8.0	3.3
Barnsdall	13,200	1.1	682	1.0	4.0	1.7
Mid-Continent	13,000	1.1	752	1.1	3.5	1.4
Total	1,162,500	100.0	69,143	99.9	240.5	100.0

On the basis of data contained in Table 2 the 25 oil companies discovered an average of approximately 17 bbl. of oil annually for each acre of prospective oil land. This is an average figure for results over a 5 to 6-year period and would be significant if the total prospective acreage under lease had been the same each year. However, between 1940-41 and 1945 their holdings of prospective oil land were increased from 50,000,000 to 91,000,000 acres, or almost doubled. During this same period the annual discovery rate for the entire United States industry remained at a static level of roughly 2,000,000,000 bbl. If this static condition also applied to the discovery history of the 25 companies under consideration, then it is evident that on a prospective acreage basis the discovery rate declined approximately 50 per cent between 1940-41 and 1945. In other words, reserves of prospective acreage in 1945 yielded only one-half the oil that they did 5 or 6 years earlier.

If, under these circumstances 17 bbl. was the average per acre result and there was a constant decline in discovery rate, then approximately 23 bbl. were discovered per acre at the beginning of the period against 11 at its end. This is an average yearly decline of about 2.4 bbl. per acre of prospective land. Assuming a continuation of this decline, the 1947 per acre discovery expectancy is about 6.2 bbl.

If present prospective oil lands now under lease represent the main source of oil to be discovered in the foreseeable future, then discovery results in terms of this acreage are more significant than results based on successful exploratory wells.

This is in opposition to the frequently heard statement that the way to find more oil is to drill more wells. That statement disregards the fact that drilling locations are not infinite, but for the present time at least are confined to acreage now under lease. This acreage embraces the industry's current opinion as to the most likely areas in which to find oil. Unless additional favorable areas are located,

TABLE 4

Group	Average annual oil discoveries		Average ownership of prospective land		Average annual successful wildcats	
	1,000 bbl.	Per cent of total	1,000 acres	Per cent of total	Number	Per cent of total
1	443,400	38.1	29,005	41.9	101.0	41.9
2	307,000	26.5	19,928	28.8	48.0	20.0
3	202,700	17.4	7,534	10.9	36.0	15.0
4	136,800	11.8	7,829	11.3	34.5	14.4
5	72,600	6.2	4,847	7.0	21.0	8.7
Total	1,162,500	100.0	69,143	99.9	240.5	100.0

TABLE 5

Group 1—Owning:	And Drilling:	Discovered:	Than Group:
145 per cent more acreage	210 per cent more wells	144 per cent more oil	2
386 per cent more acreage	280 per cent more wells	218 per cent more oil	3
385 per cent more acreage	293 per cent more wells	325 per cent more oil	4
603 per cent more acreage	481 per cent more wells	611 per cent more oil	5

TABLE 6—TWENTY-FIVE OIL COMPANIES ARRANGED ACCORDING TO CALCULATED RELATIVE PROSPECTS (JANUARY 1, 1946) FOR PERCENTAGE IMPROVEMENT IN DOMESTIC CRUDE-OIL RESERVES

(Results are based on anticipated discoveries in terms of prospective acreage and past discovery results)

(A)	(B) Prospective acreage* (1,000 acres)	(C) Annual production (1,000 bbl.)	(D) Acres per bbl. of production	(E) Discovery efficiency	(F) Relative index number
Atlantic	†4,469	25,000	.178	1.4	.2492
Superior	¶3,500	16,000	.219	.9	.1971
Sun	7,310	27,000	.271	.7	.1897
Argo	240	1,900	.126	1.5	.1890
Amerada	1,165	18,000	.065	2.7	.1755
Tide Water	1,990	32,000	.062	2.4	.1488
Phillips	4,067	34,000	.119	1.2	.1428
Standard of Indiana	8,336	65,000	.128	1.1	.1408
Mid-Continent	776	5,700	.136	1.0	.1360
Sinclair	5,100	26,000	.196	.6	.1176
Union	§776	26,000	.030	3.7	.1110
Humble	16,513	112,000	.147	.75	.1102
Skelly	1,732	13,000	.133	.8	.1064
Standard of California	†2,869	74,000	.039	2.6	.1014
Shell	3,524	70,000	.050	2.0	.1000
Texas Pacific Coal & Oil	†400	4,500	.090	1.1	.0990
Pure	2,852	29,000	.098	1.0	.0980
Barnsdall	688	9,500	.072	1.2	.0864
Richfield	413	8,600	.048	1.8	.0864
Gulf	10,467	75,000	.139	.6	.0834
Texas	†9,400	85,000	.110	.75	.0825
Continental	1,752	34,000	.051	1.5	.0765
Ohio	§2,100	32,000	.065	1.0	.0650
Honolulu	†332	12,000	.028	1.9	.0532
Houston	‡607	3,500	.173	.23	.0398

*Prospective acreage figures as of December 31, 1945. Derived from company reports and statistical services unless otherwise noted. †Estimate based on company's report of combined producing and prospective acreage. ‡Includes company's 50 per cent ownership in 805,000 acres. §Estimate based on company's report of prospective acreage owned in 1944 and 1946. ¶Estimate based on 1946 ownership of prospective acreage.

drilling more wells in response to demand is only a temporary cure, which in the long run hastens the discovery and depletion of oil on land now regarded as favorable.

Fortunately, the industry during recent years has, with its constantly expanding program, maintained a healthy position by a comparable expansion of its reserves of prospective acreage.

Future Domestic-Discovery Prospects

Table 6 shows the calculated relative standing of 25 companies with respect to their prospects for improving their domestic crude-oil reserve positions on a percentage basis through future discoveries. Relative standing is based on the index number in the last column of the table.

This index was obtained by dividing 1946 annual domestic production, column "C," into reserves of prospective land, column "B," which yields the fractional number of acres per barrel of production, column "D." If all companies were equally efficient in converting their prospective acreage into crude-oil reserves, this figure would reflect their relative prospects for improving their reserve position.

However, since companies are not equally efficient in this respect a factor, column "E," expressing this difference in efficiency, based on historic results, has been computed which, multiplied by "acres per barrel of production," column "D," gives an index expressing the relative prospects of companies for improving their domestic crude-reserve positions. This index reflects the combined influence of both the acreage holdings and efficiency element.

The efficiency factor used in column "E" Table 6 is derived from the results in the last column of Table 2, which shows the average annual barrels of oil discovered during recent years by each company for each acre owned.

It is to be noted that the index number in column "F" of Table 6 is not a measure of quantitative expectancy with respect to crude-oil acquisition or gross additions to domestic reserves. It is a measure of expectancy governing the prospects for improvement of crude-oil reserves on a percentage basis. Thus, Humble ranks foremost with respect to probable quantities of new oil to be discovered and added to reserves in the future. But, on a percentage basis, additions to reserves after withdrawals will probably be considerably less than the percentage additions anticipated for many other companies on the basis of Table 6.

It is important to note that the discovery expectancies presented herein are deficient in two respects. First, no provision is made for the rate at which prospective acreage is tested and replaced. Thus, of two companies having the same amount of prospective acreage, that company's acreage which is tested and replaced at the higher rate may be expected to find the greatest quantity of oil. Secondly, no adequate provision is made for the geological quality of prospective acreage now held by each company. Accordingly, the relative prospects presented in Table 6 should be considered in the light of these deficiencies, or, in other words, as measures of approximate expectancy only.

With respect to some of the individual companies listed in Table 6, the following comments are made. The element of personal opinion and ideas which are injected into these comments are garnered from indefinite sources, and are admittedly a poor substitute for the factual information which the author lacks.

Atlantic.—With extensive reserves of prospective acreage and a better than average record in converting such acreage into oil reserves, this company ranks first with respect to prospects for effecting percentage increase in reserves.

Superior.—The favorable indicated expectancy for Superior is based largely on its substantial holdings of prospective acreage, much of which, however, is believed to be located in highly speculative areas where conversion into oil reserves may be long delayed. Offsetting this condition is an historical discovery efficiency which is actually higher than that indicated in Table 6. The factor of 0.9 is distorted on the low side by measuring past discoveries against prospective acreage the greater part of which was acquired at the end of the period and which consequently was not a material factor in the over-all discovery results.

Sun.—Despite a subnormal discovery rate per acre, which is regarded as a measure of discovery efficiency, Sun ranks third in the table by virtue of its extensive ownership of prospective acreage. Like Superior, it is believed that much of Sun's acreage is checkerboarded and located in highly speculative areas.

Sun's past record in improving its crude-oil-reserve position is estimated to rank first among the 25 companies considered here.

Amerada.—Reflecting a preference for quality acreage based on high-quality geophysical investigation, the company's per-acre discovery record is exceeded by only one other company. However, its low acre-production ratio places it number 5 in the table with respect to future prospects.

Sinclair.—The company's current prospects appear favorable, if its extensive ownership of prospective acreage represents average quality. Acreage has been increased approximately 70 per cent in the past 6 years. This expansion is regarded as an attempt to bring crude-oil reserves and production into balance with refinery requirements. The company's per-acre discovery record is comparable to that of Gulf and Sun.

Union.—This company, next to Honolulu, has the lowest acre-production ratio of the 25 companies considered. Its efficiency rating is the highest of all the companies. This indicated rating not only reflects the discovery of additional oil reserves

(Continued on page 106)

"Oilwell" TC-6 Pumping Units keep *ROLLING* along

because . . .

Roller bearings give maximum efficiency where there is complete rotation

For an indication of quality in pumping units, look at the bearings!

Note that the crank and lower connecting rod, illustrated, are equipped with *double roller self-aligning roller bearings*. These bearings are grease-lubricated and enclosed in weatherproof one-piece steel housings equipped with grease seals, Alemite and pressure relief fittings. Steel wrist pins with tapered shanks are an added feature.

Check next, the D-6 Reduction Gear, illustrated above. It is a double reduction type with fully heat-treated and machine-cut gear teeth of the single helical type having long and short addendum tooth form. The crankshaft and high-speed pinion shaft, extending through both sides of the gear case, are mounted on *shim adjustable, large capacity tapered roller bearings*. This feature provides for maximum operating efficiency and long life.

In every instance lubricant is sealed in . . . dust and grit are sealed out with replaceable oil seals.

SPECIFICATIONS

A.P.I. Peak-Torque Capacity at 20 S.P.M. Inch-Pounds	A.P.I. Polished-Rod Load Capacity Pounds	Stroke-Range Inches
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PRE*planning and fabrication*

Keys to rapid reconstruction of cracking-coil furnaces

by R. S. Armstrong

This article outlines, step by step, the procedure employed in making economically extensive repairs to a cracking furnace. By careful planning the labor to total cost of the project was kept to an approximate ratio of 8 : 51. Total downtime was held to 19 days even though labor overtime was kept to a minimum.

The entire job from preparation of cost estimates through material purchasing and scheduling and labor supervision was handled by the refinery's regular staff. The author is maintenance engineer in the manufacturing department at the Lima, Ohio, refinery of Standard Oil Co. (Ohio).

THE cracking-coil vapor-phase furnace at the Lima refinery of Standard Oil Co. (Ohio) had required extensive maintenance for several years. It was apparent that major repairs or replacements were necessary to maintain throughput, on-stream time, and safe working conditions.

Periodic inspections and photographs showed gradual deterioration of the furnace. Replacement with a new furnace would be too expensive and take too long due to material shortages. Thirteen months before the rebuilding of the furnace, this minimum scope of work was determined:

1. The five roof girders (20-in. I-beams with builtup flange sections).
2. Both roof-header compartment boxes.
3. All roof tube hangers.
4. All roof tubes and headers.
5. The brick work in the right and left walls up from a point several feet below the roof header compartment box, and the front wall corner pilasters for about 8 ft.

An outside contractor submitted a time estimate of 4 to 6 weeks. The plant superintendent, chief engineer, master mechanic, and involved craft foremen studied the possibility of rebuilding the furnace using plant forces. They decided the work could be accomplished in less than 4 weeks at a very favorable cost figure compared to the contract estimate. The work was scheduled during the 1947 spring general inspection.

An estimate was submitted, passed by the board of directors, and the material began to arrive in the plant in October 1946. Prefabrication was started in February. On April 20 the cracking coil was brought down for general inspection and mechanical work started the following day.

Work on the furnace was completed on May 7, and the furnace fired for operation May 9, after a downtime of 19 days. It must be remembered that the furnace rebuilding was carried on in conjunction with the regular general inspection work.

Labor costs were less than $8,000. The actual offstream time was one-half of the estimate by an outside contractor. Total cost, $50,736, including material, was 6½ per cent under the refinery estimate cost of $54,305. The difference was due to minimizing overtime and the work progressed, with one exception, without delay.

A preliminary schedule was first established in setting up the estimate for the rebuilding of the furnace. This schedule covered the general steps to be taken in the dismantling and clearing of the site with the subsequent rebuilding of the furnace. Any prefabrication was handled separately.

Schedule of Work

The general steps established for dismantling the furnace by removal of components were:

1. The roof.
2. Thermocouples and wiring.
3. Header boxes and tubes.
4. Roof insulation and roof arch block.
5. Header compartment boxes.
6. Tube hangers.
7. Structural steel.
8. Brick work.

The engineering department, for purposes of estimating costs, made a careful and thorough analysis with the craft foremen performing the work. Time estimates were set up. These estimates, along with the prefabrication estimate separately set up, formed the final estimate submitted to the board of directors.

When the delivery dates for the material were known, a flexible prefabrication schedule was set up by the master mechanic. This schedule gave only the sequence of items to be prefabricated and desired target dates for completion. The flexibility was required to coordinate this shop work with maintenance jobs current at the time of material delivery. The final firm scheduling of prefabrication, after receipt of material, was done during the daily mechanical meeting held each morning by the master mechanic.

Three "Completion Check Lists" were set up by the maintenance engineer. The first list was a complete material list giving all items, requisition numbers and promised delivery dates. The second list covered items being fabricated under contract, such as headers, arch block, tubes, arch-block support bars, and so forth. The third list covered prefabricated items being made by the plant forces.

The "completion check lists" for material and items for contract were reviewed biweekly by the maintenance engineer from October until March 15. From this time on, it was necessary to review the material list weekly to insure no delay in prefabrication. A "receipt of material" notice was passed to the boiler shop foreman and master mechanic by the storekeeper for each item as received. Where items were overdue, the maintenance engineer started a "punch up." These followups were effective. In several cases, substitutions were necessary to keep the work progressing—for instance, 4 by 7-in. angles were substituted for 4 by 4-in. angles,

and in another case, it was found necessary to make up some 9-in. channel from 3 by 3-in. angles and boiler plate rather than wait on a late delivery date.

The completion check list for prefabrication was brought up-to-date daily in the master mechanic's mechanical meetings. This list was used primarily, along with the other check lists, to provide control reports to the plant manager and superintendent on the estimate progress. These control reports, submitted March 15, March 31, and April 15, gave:

1. The progress of work since the last report.

2. Prefabricated items completed and contract items received, with disposition.

3. Material items not yet received with the followup action taken, and the most recent promised delivery date.

A number of material items required by the estimate in small quantities were commonly used for current maintenance jobs, such as boiler plate, rivets, and bolts. These items were taken from stores, rather than issue purchase orders covering the small required amounts. To be sure of no shortages in these items, the maintenance engineer reviewed the storehouse stocks twice monthly, from January until the shutdown, and had supplementary stock requisitions placed where quantities fell below the estimated safe minimum.

At the Lima refinery, the boiler-shop foreman is in charge of the carpenters and brickmasons, the labor foreman in charge of automotive and handling equipment. Therefore, practically all work on the furnace was accomplished by crafts under these foremen. This simplified, to a great extent, the setting up of a schedule for the actual construction work. This schedule was worked out in detail for the several gangs by the two foremen and the master mechanic, showing personnel, shifts, concurrence and sequence of jobs, and estimation of completion times.

Since a copy of this schedule is not available for illustration, an explanation of how it was established is in line. First, the master mechanic set up the sequence and concurrence of the various steps along with the desired target time. Then, in cooperation with the labor and boiler-shop foremen, available first-class men were individually assigned the various jobs for each shift around the clock. The necessary number of helpers and labor were assigned in number only, the individual assignment being later made from the "personnel assignment roster."

Upon submission of the actual construction schedule to the plant superintendent and its subsequent approval, it was integrated with the other general inspection work for the entire shutdown.

During the 2 weeks prior to the shutdown, several general meetings were held with all craft foremen, master mechanic, process foremen, and plant superintendent. Previously prepared work summaries covering all known work to be accomplished were gone over in detail, points of responsibility marked off, work sequence and coordination established, and labor requirements determined.

Immediately following these meetings, a personnel assignment roster for all available process and mechanical men was made up by the maintenance engineer and approved by the master mechanic. This assignment roster had the personnel listed in order of plant seniority, and indicated the craft assignment for each individual for 2 weeks in advance. Another roster was prepared showing the shift worked for the personnel working other than the day shift. These two rosters were held in the master mechanic's office.

Labor Assignments

Upon completion of the personnel assignment rosters, it was found necessary to make some minor revisions in the construction schedule previously set up, due to the shortage of a crane operator and common laborer for the midnight shift. Some changes to the rosters were foreseen as necessary to meet changes in labor requirements and to accomplish unforeseen work disclosed by the metal inspectors. Rosters showing assignment for only 24 hours in advance were posted daily by the time clock. There each workman could check his assignment and shift. It has been found that when the rosters were published more than 24 hours in advance and subsequent changes made, confusion often resulted and time was lost when men reported to work on the wrong job.

All tools and equipment were checked by the using craft foreman and overhauled where necessary, prior to shutdown. For instance, tube cleaners and hose were inspected to insure first-class condition, welding machines were overhauled to insure peak efficiency. All these items plus their maintenance items and equipment were delivered to the site of work by Friday, or before the shutdown. Items for the furnace repair had been stored on the site upon completion of prefabrication or receipt from supplier.

It might be well to point out here that the blue prints, from which the prefabrication and construction were made, were prints from the original tracings made when the furnace was built in 1931. Many of the present workmen and supervisors were employed in the original construction. The master mechanic was the engineer who drew up the plans. This aided materially in the planning and actual work of rebuilding as the familiarity with the plans and job enabled the work to proceed more rapidly.

Since new header boxes of a type not previously used were being installed to replace the old header boxes, the boiler-shop foreman had a trial rolling or dry run upon receipt of the headers prior to the shutdown. This dry run was undertaken for several reasons:

1. To determine the best and least time consuming method of rolling.

2. To familiarize the workmen with the new rolls and any changes in rolling technique.

3. To insure that the tools on hand were capable and adequate for the job.

The first attempt at a trial rolling showed that a motor heavier than those on hand was needed, since the new header tube seat was about ¾ in. longer than the old-style header, and the new rolls reached farther into the tube. A larger motor was borrowed for a few days. Test runs were made and the motor proved to be capable of doing the job, so a similar motor was ordered and received prior to the shutdown.

The cracking coil was brought down Sunday evening, April 20; header compartment and fire doors were opened immediately for cooling, the coils pumped out and steamed. On Monday morning at 6:30, pipe fitters started blanking off the furnace ready for the remaining mechanical crafts to begin work at 7:30.

Tube Hanger Placements

All work on the furnace proceeded smoothly for the first 3 days until the end tube hangers were being placed. Each fahrite hanger was approximately 1/32 in. oversize and the complete assembly was ⅞ in. off. A check of the supplier's prints indicated he had given himself a tolerance of 1/32 in. with no note being made that the tolerance had to be undersize, the exact dimension being the maximum. While each hanger had been checked individually upon receipt, the hangers had not been checked as assembled. It was necessary to plane the edges of the sheets, which was accomplished by our machine shop. This time was not entirely lost, however, as the men went from the furnace to other general inspection work and returned to work on the furnace after the hangers were finished.

The remainder of the work on the furnace proceeded without interruption or difficulty and was completed on May 7. Fires to dry the new insulation had been lighted May 4. The cracking coil started up May 9, 19 days after coming down.

The value of preplanning and scheduling was evident here as shown by the great difference of actual labor cost of repair by the plant forces, $8,000, and the contract bid of over

(Continued on page 112)

Zinc Anode Protection Installed During Pipe-Line Construction

by Otha C. Roddey

CATHODIC protection of new pipe lines using sacrificial anodes is becoming widely accepted as a solution to the corrosion problem in natural soils. Coatings of proper electrical resistance and minimum moisture absorption with age, and which are inert to soil chemicals, are an accessory to corrosion mitigation. The distributed-anode method affords a uniform pipe-to-soil potential gradient along the length of line and requires fewer rods for full protection. With a ground bed designed for an average of 25 ma. from anodes weighing 17 lb. each, the theoretical life of the drainage system will approximate 28.8 years. In addition to the low installation costs, another advantage of the sacrificial anode lies in the fact that there is little or no maintenance costs on such a system. The author is general superintendent of Interstate Natural Gas Co., Inc.

CATHODIC protection of buried ferric structures is accomplished by introducing a direct current into the soil in which the structure lies, counteracting such currents as may flow outward from the structure. This may be accomplished by either of two methods: (1) By forced drainage in which an external source of power, such as a rectifier, motor-generator set, or windmill is used for forcing currents into the soil, and (2) by the galvanic-anode method which utilizes the voltage differential existing between metals in the electromotive series.

On its Baton Rouge-West natural-gas pipe-line system, which extends from North Tepetate field in Acadia Parish, Louisiana, to Baton Rouge, Interstate Natural Gas Co., Inc., installed cathodic protection using zinc as the galvanic-anode material. Anodes were placed at various intervals along the right-of-way by sections, using the distributed-anode method with single rods at each location. Rods and their connecting wires were installed at the time the pipe was being laid, saving the cost of digging bell holes for attaching the ground wires to the pipe. This line, completed in March 1946, is 83.5 miles in length, consisting of 18 miles of 12-in. with ¼-in. wall thickness, and 65 miles of 16-in. with a 9/32-in. wall.

It has been the general practice in the pipe-line industry to postpone the application of cathodic protection for the mitigation of corrosion on new lines for some years following construction. This has been due in part to the thicker-walled pipe used formerly and the belief that a near-perfect covering had been applied. In the use of heavier-walled pipe, many years are required for corrosion penetration except in the most concentrated corrosive areas.

Penetration time of the present high-strength thin-walled pipe is much shorter than would be predicted from a consideration of wall thickness alone. The reason is that under most soil conditions the rate of maximum penetration decreases as the period of exposure increases.

Coatings

In the application of protective coatings to pipe lines which are to receive electrical drainage immediately or at some future date, such coverings must have the following general properties: A good electrical insulation, low moisture absorption, and be inert to soil chemicals. Present-day pipeline enamels fulfill these requirements if properly installed, properly handled in laying, and protected by a durable reinforcing wrapper.

The wrapper acts as a shield against rough backfills of stones, hard clay soils, broken tree roots, and soil stresses. Soil stress causes severe distortion and general covering displacement over the entire pipe surface if not protected by a reinforcing wrapper. Experience shows that in some alluvial soils of Louisiana, soil stress will pull the covering from the pipe, leaving it bare and subject to corrosion if no wrapper is applied.

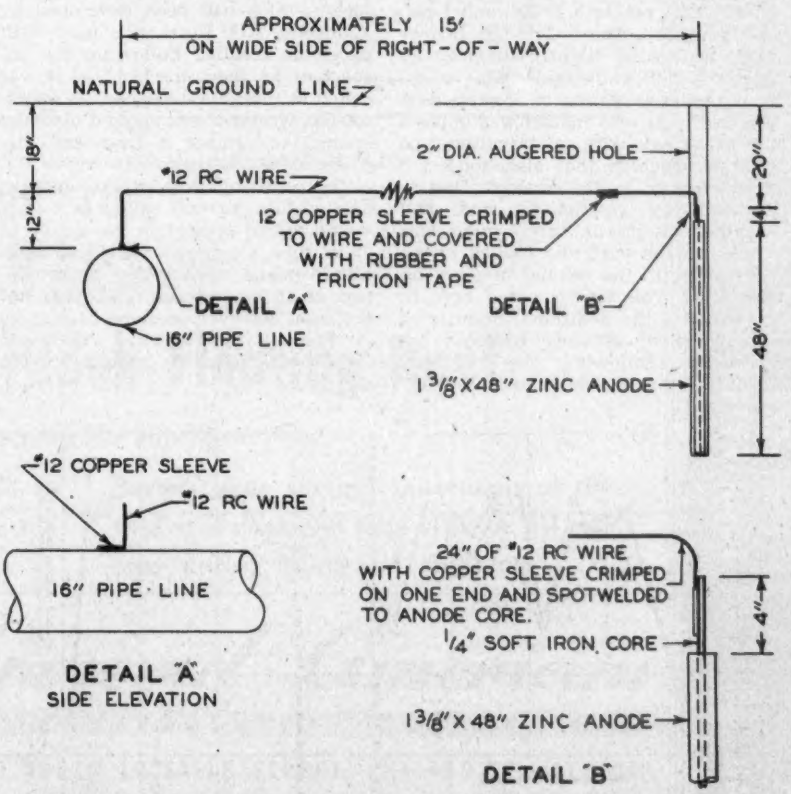


Fig. 1—Typical installation of zinc anodes on Baton Rouge-West pipe-line system of Interstate Natural Gas Co., Inc. Notes: No. 12 copper sleeve to be compressed on end of No. 12 R. C. wire and fused to pipe with ½-in. carbon rod, using four six-volt batteries connected in series. Parts of pipe left bare after fusing to be hot enameled and covered with asbestos felt

In applying enamels on pipe lines a base or primer must first be used. It has been the experience of the writer that a thin coat of primer, one through which the gray steel surface of the pipe shows, will produce the best bond between pipe and enamel. A thick coating of primer may take many hours to dry thoroughly, with the result that the outside surface is apt to become dead and lifeless before the remainder of the primer coating has become sufficiently dry to permit satisfactory application of the enamel. The outside appearance may indicate a dry primer, but upon applying the hot enamel pin holes may result, and upon close inspection, a green primer will be found at the pipe surface.

While laying the line which this article treats, temperatures sometime reached a low of 15° F., and difficulty was experienced in securing the proper thinness of primer, and drying time was prolonged over a period of hours. Upon consulting the manufacturer of the enamel and primer, varsol was recommended as a thinner, the quantity of thinner added being inversely proportional to the temperature; that is, the lower the temperature the greater the amount of thinner. Satisfactory results were secured by mixing 1 gal. of varsol to each 5 gal. of primer at a temperature of 15° F., 1 gal. to 8 at 20°, and 1 gal. to 12 at 24°. Above 26°, the primer may be heated slightly in order to secure a uniformly thin coat.

With the exception of 7 miles near Baton Rouge, the enamel was applied in the field with a traveling-type coating machine that also bonded a felt wrapper to the enamel. Due to right-of-way restrictions and bad weather conditions, this 7 miles was coated in the yard and hauled to the location with the enamel in place on the pipe. This fact is noted here to account for the additional number of zinc rods which were required for protection following the handling after coating. It has been found impossible adequately to repair damages to coatings except in minor pin holes and holidays which occur in the painting process. A minimum coating of 3/32-in. has been found to be the most effective in corrosion mitigation and in offering the greatest resistance to soil stresses and moisture absorption.

On 13.8 miles through the Atchafalaya floodway, a ⅝-in. coat of Somastic was applied in the yard at the railhead. In special cases, such as this, Somastic offers two principal advantages over enamel coatings: (1) A ⅝-in. application adds a net weight of 16.46 lb. per foot on 16-in. pipe, against a buoyancy or slightly floating effect of a 3/32-in. coating of enamel and wrapper. (2) Where anchor weights are required to sink the pipe in bayous and canals the hardness of Somastic is such as to support the weights without destroying the electrical insulating value and creating bare areas which must be protected cathodically.

Zinc Anodes

In 1932, along with other cathodic-protection experiments conducted by Interstate, an effort was also made to improve the method of applying the coverings to its pipe lines. To supplement and replace the visual inspection of coatings, a holiday detector which had been developed by Johns-Manville Corp. was used with excellent results. Following the inspection by the "snitcher," as it was called in pipe-line parlance, an asbestos-felt wrapper was applied over the enamel to protect it from soil displacements and stresses.

The result of these experiments indicated that currents as low as 1 amp. would afford protection for a mile of 22-in. pipe. Currents of this low magnitude might indicate that no protection at all was necessary. This is not the case, however, as some bare spots or holidays will always exist and these areas must be protected from corrosion.

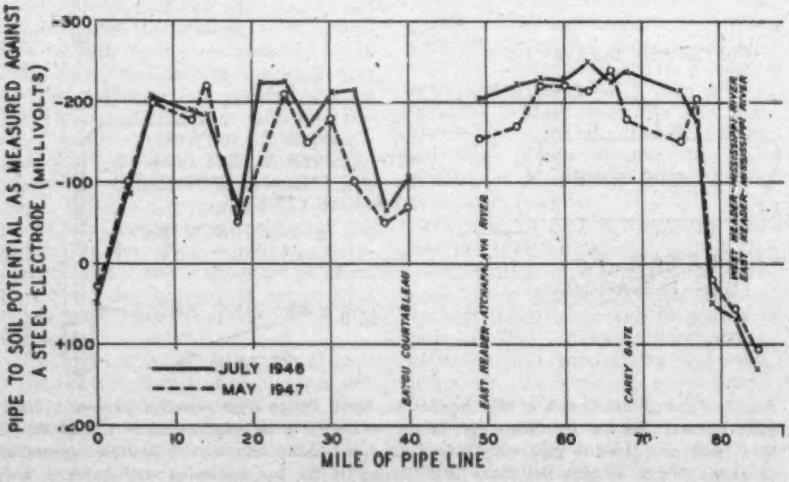


Fig. 2—A survey of pipe potentials 5 months and 15 months after construction

The sacrificial anode is ideally adaptable to installations of this kind. Zinc with its high current-output efficiency, in the order of 98 per cent in the high-purity state, and long life, was selected as the anode material on the line. An analysis of the 2,256 zinc rods installed on this 83.5 miles of pipe line showed an average of the following elements:

Zinc	99.980
Iron	.025
Lead	.010
Cadmium	.005

Anodes were cast, 1⅜-in. diameter, 48 in. long, weighing an average of 17.8 lb. each, with a ¼-in. soft iron rod through the middle. Fig. 1 shows a typical anode installation and connections to the pipe and soft iron core of the rod. Rods were set approximately 15 ft. away from the pipe in 2-in. augured holes, 68 in. deep and connected to the pipe with a No. 12 rubber-covered wire. Nicopress copper sleeves, such as are used in repairing telephone wires, were attached to the connecting wires and these sleeves then fused electrically to the pipe and soft iron core of the rod.

Power for fusing the sleeve to the pipe and core came from four 6-volt heavy-duty storage batteries connected in series, giving a total of 24 volts. The ordinary electric-arc-welding cables and electrode holder were used for carrying currents to a ½-in. carbon fusing rod and ground return.

This equipment, together with materials for patching the enamel following each connection, was mounted on an ordinary sled which was drawn along the right-of-way by a mule at a cost of $4.00 per day. A set of well-charged batteries made an average of 75 connections before requiring a recharge. This equipment replaced a welding machine and tow tractor, the cost of which would have been $175.00 per day.

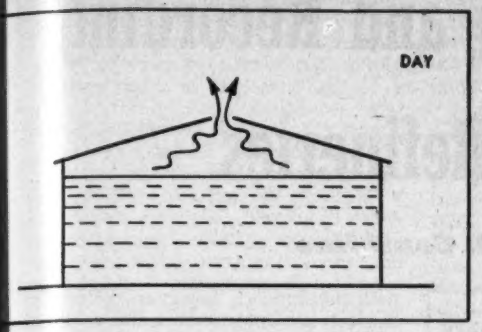
Corrosion Survey

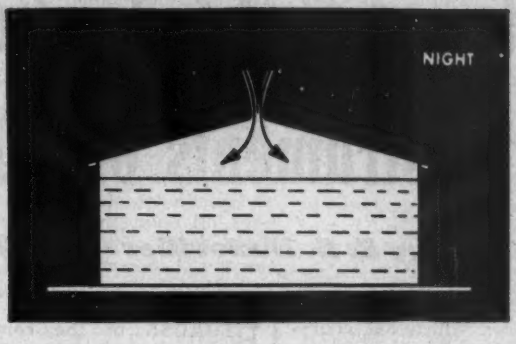
In considering cathodic protection of new lines where corrosive conditions are not known and no records are available, a methodical survey must be conducted. Soil resistance, soil classifications, and pH tests must be made at intervals along the proposed right-of-way. The corrosion engineers on the Baton Rouge-West line were materially assisted by information gained from the experience of operators of other pipe lines in the same general region. With this information, penetration rates, corrosion activity, and the location of "hot spots," were determined on more than 60 per cent of the line before construction.

The pipe and paint inspection, to the extent of estimating the percentage of bare pipe, was also considered a part of the corrosion survey. In the final analysis of such a survey, cur-

(Continued on page 105)

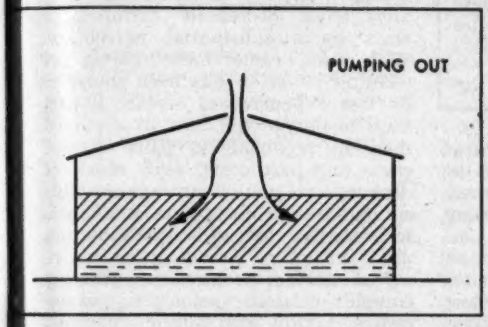
STANDING LOSSES

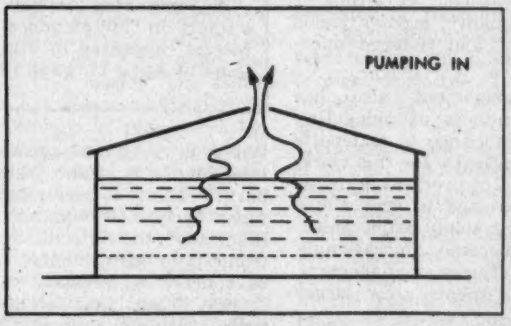




Standing losses vary from 2 to 4 percent of the tank volume per year, depending on the tank size. In addition, the value of the gasoline is reduced through vapor venting.

PUMPING LOSSES





Pumping losses may be conservatively estimated at 0.16 percent of the liquid volume pumped.

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Maintenance of Indicating and Recording Instruments of Oil Refineries

by E. D. Nuneviller and D. M. Considine†*

THE trend toward more and better instrumentation which has characterized the petroleum industry over the past several years has brought with it the need for specialized skill required to install and to maintain scores of different types of instruments utilized in measuring and controlling the many variables encountered in refinery processing. The over-all economic soundness of increased expenditures for instrumentation has been proved in terms of better product quality, greater yields and throughputs, and reduced operating costs.

Refinery management also has proved the soundness of delegating instrument maintenance to a department set up specifically for this work. And as the value of preventive maintenance, as contrasted to spot maintenance resulting solely from emergency calls, became increasingly popular with refinery management, instrument departments grew larger and larger.

Naturally, with the cost of skilled labor increasing as it has during the last few years, management cast an interested eye at the instrument department and at servicing and maintenance costs. It was not surprising, then, that the introduction of electronic-type instruments was a cause of concern to refinery management in that it was first felt that to keep such instruments in first-class operating condition would require the services of instrument men highly trained in the generally regarded complex field of electronics. Even with this concern, however, thousands of electronic instruments and controls were installed over the past 7 or 8 years and experience has proved that electronic experts are not required to use or to maintain them.

Experience has further proved that instruments of this type, with their fewer moving parts to wear and to adjust, with their design for unit parts replacement, and with increased ruggedness over their more complicated, mechanical counterparts, actually have decreased maintenance costs by a substantial percentage. With unit replacement parts, for example, it often has been found to be less expensive to replace a part than to devote the time of a skilled man to repairing it. This is true since unit-part costs, as a result of design and manufacturing simplification through electronics, are down, whereas the costs of skilled labor are up.

Just as the modern refinery involves complex scientific principles and requires highly specialized engineers to design it, but which is best operated and maintained in service by men with practical rather than theoretical training, so it is with elec-

BECAUSE of the comparative newness of electronic instruments to the refinery field, this article will be devoted to a consideration of the general maintenance problems involved with such instruments. The authors show that electronic instruments are just as easy, and in most cases more convenient to maintain than mechanical instruments.

A companion article by these authors on "Maintenance of Orifice Meters" appeared in The Journal's issue of April 15, page 107.

*Supervising service engineer and †application engineer, Brown Instrument Co.

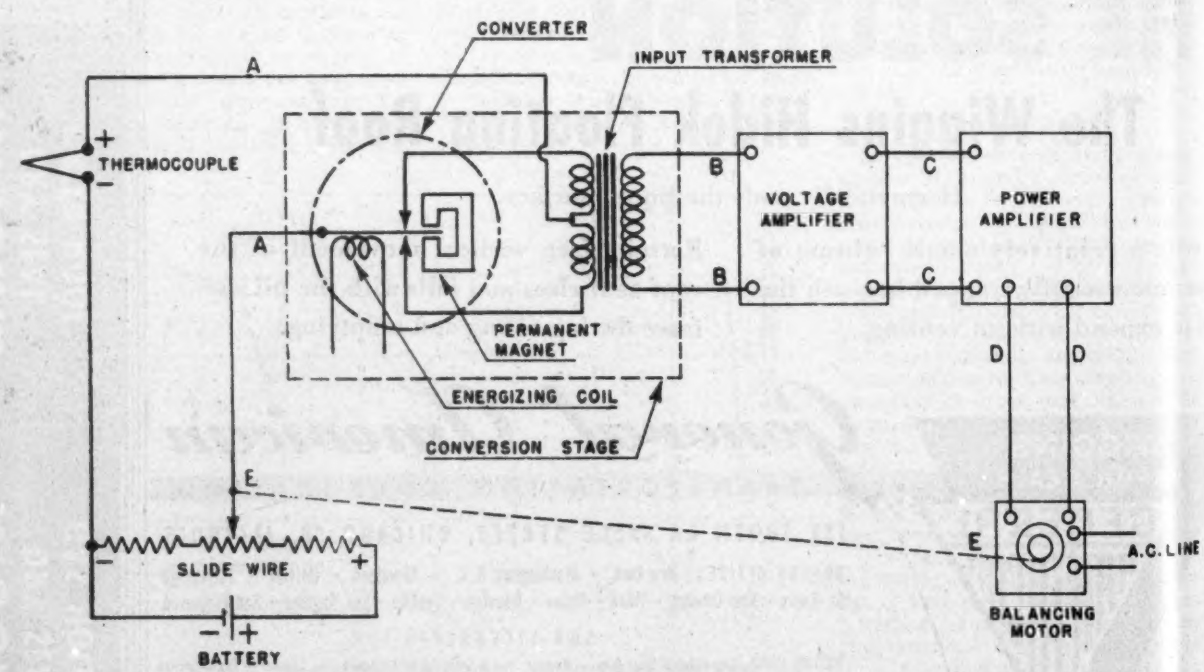

Fig. 1—Schematic diagram of Brown continuous balance system (used in potentiometer circuit)

tronic instruments. Rather than applying the complex equations and mathematics required to design an electronic instrument, the maintenance of such an instrument simply reduces itself to the checking of a comparatively few resistances and voltages. Absence of numerous levers, gears, and other mechanical components in electronic instruments makes the isolation of trouble a much easier task. Through color-coded wiring, clearly marked and easily accessible terminal blocks, and completely interchangeable and easily replaceable components, the up-to-date manufacturer of modern electronic instruments has done much to streamline and take the drudgery out of instrument maintenance.

By listing the major components of an electronic potentiometer, an analysis of the over-all maintenance of the instrument will be simplified. A schematic diagram of the instrument to be analyzed is given in Fig. 1. The functions of the major components shown are summarized as follows:

1. **Conversion stage.**—This is composed of the converter and transformer and its purpose is to convert the unbalance d.-c. thermocouple voltage to a proportional a.-c. voltage. (See Fig. 2.)

2. **Converter.**—This is a single-pole, double-throw switch operating in synchronism with line voltage. The switch is polarized by means of a permanent magnet so that one of the contacts will always be closed during the positive half-cycle of the supply voltage and the other contact will always be closed during the negative half-cycle.

3. **Transformer.**—This acts as a coupling device between the measuring circuit and the electronic voltage amplifier. It has a dual input and, in conjunction with the polarized converter, supplies an a.-c. voltage at BB, whose magnitude is proportional to the d.-c. unbalance of the measuring ciurcuit and whose phase is dependent upon the direction of unbalance.

4. **Voltage amplifier.**—This multiplies the a.-c. voltage at BB, (Fig. 1) from one of the order of microvolts to one of several volts at CC. (Fig. 1.)

5. **Power amplifier.**—This is controlled by the voltage at CC and delivers driving power at DD to the balancing motor. Both the phase and magnitude of this driving power are directly controlled by the voltage at CC.

6. **Balancing motor.**—This is a brushless, reversible, variable-speed induction motor which recognizes the phase of the driving power and accordingly balances the instrument. One of the motor windings is continuously energized by line voltage. The other winding is energized by the power amplifier, with a current whose phase with respect to the line current determines the direction of rotation of the motor. The slide-wire contactor, pen, and pointer are directly connected to this motor; hence the instrument is continuously maintained in balance.

7. **Indicating and recording means:** (not shown in Fig. 1). The balancing motor is directly connected to a means to indicate and record the value of the measured variable on a round or strip chart, depending upon the type of instrument involved. Where multiple recording is concerned, a printwheel mechanism usually will be involved.

Testing and Trouble Shooting

Before the individual components just listed are tested, the cause of difficulty must be isolated. Procedure for general testing and trouble isolation is outlined in the following section.

Equipment required.—A simple test meter, capable of measuring up to 1,000 volts d.c. and a.c. is required. Preferably, this meter should have a sensitivity of 20,000 ohms per volt on d.-c. volt ranges and 1,000 ohms per volt on a.-c. volt ranges. The meter should have ohmmeter ranges permitting measurements of resistances between 1 ohm and about 5 megohms. It should have an output meter arrangement so that a.-c. voltages can be measured independently of any d.-c. component which may be present. The output meter consists of a condenser in series with the a.-c. voltmeter. An accuracy of 2 per cent is generally satisfactory for this meter.

A portable potentiometer with the galvanometer short circuited or clamped is used to furnish potential to the thermocouple terminals of the instrument. Accuracy of calibration is not important when this instrument is used to check general operation, but it must be remembered that the usual type of portable potentiometer is not sufficiently accurate as a checking standard, especially where narrow ranges are involved. The laboratory type of precision potentiometer should be used as a standard for checking calibrations, cold junction compensation being supplied by means of an ice bath.

Checking where no balancing motor drive is obtained.—Where this condition exists, the following procedure should be followed to isolate difficulty:

1. Check line voltage at terminals of junction block at instrument. Failure of line voltage to appear may be due to: (a) defective power cable, (b) defective switch, and (c) incorrect power circuit connections.

2. Operate motor manually to determine if any excessive friction exists.

3. Check voltage of motor drive and associated parts, such as motor capacitor and motor windings. These voltages should come up to manufacturer's specifications.

4. With the instrument turned off, the motor fields should be checked for d.-c. resistance, which will indicate whether the fields are open-circuited or short-circuited.

5. With the instrument turned on and with a portable potentiometer connected to the thermocouple terminals, measure with an a.-c. meter the voltage appearing across the motor terminals. As this input voltage is varied, the voltage shown by the a.-c. meter should vary, as given in the manufacturer's specifications.

This test determines whether or not the amplifier is supplying potential to the motor. If potential is supplied to the motor without rotation, the motor or motor capacitors should be checked as explained previously. If potential is not supplied to the motor, the difficulty is in the amplifier and the amplifier should be checked. (See resistance and voltage checks described later.)

If this latter check shows the amplifier to be satisfactory, check the measuring circuit to determine whether it furnishes a potential to the amplifier in accordance with the unbalance in the circuit. Disconnect

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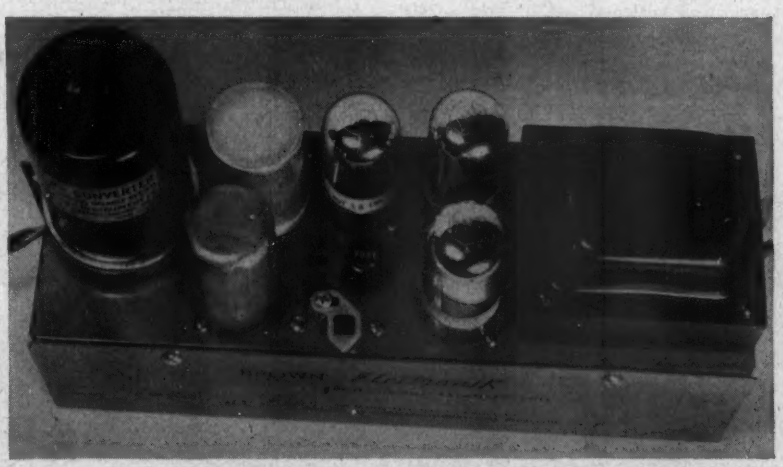

Fig. 2—Continuous balance unit

Nitrogen Removal from Natural Gas

PART 2

THIS article and its companion piece which appeared in the April 15 issue constitute a monumental reference work on a subject not heretofore consolidated in one place. Also discussed in the author's treatment are a background in air and other low-temperature separation methods and gas dehydration, and carbon dioxide and hydrogen sulfide removal.

by W. W. Deschner and W. W. Bodle

THE problem of separation of nitrogen from natural gas by low-temperature fractional distillation resolves itself essentially into the separation of nitrogen from methane. Hydrocarbons heavier than methane occur in relatively small proportions in the natural gas and may be condensed and removed from the feed-gas stream as the gas is cooled to fractionation temperatures. It is therefore essential that liquid-vapor equilibrium data for nitrogen-methane mixtures be available for calculations on the fractionation system.

Experimental liquid-vapor equilibrium data on the system nitrogen-methane are not abundant. Ruhemann[20] presents a plat of the data of Torocheshnikov and Levius[24] for the nitrogen-methane system over the entire range of concentrations for temperatures between —297° and —220° F. Recently, Brown and Stutzman[5] presented a correlation of available data on equilibrium constants for nitrogen, methane, and ethane at low temperatures. These authors[25] also determined, experimentally, the vapor-liquid equilibrium of nitrogen and methane in natural gas for temperatures between —130° and —240° F., at 100 psia.

The vapor-liquid equilibrium data may be estimated from the fugacities of the pure components if it is assumed that perfect solutions are formed. (Fig. 1 of the previous article shows the vapor-liquid composition diagram for methane and nitrogen.) The fugacities of methane were taken from the data of Matthews and Hurd[23] and those for nitrogen were estimated from the generalized activity coefficient chart of Newton.[18] Points are shown from the data of Torocheshnikov and Levius[24], the correlation of Brown and Stuzman,[5] and the data of Stutzman and Brown[25] at 100 psia.

Vapor-liquid equilibrium data available leave some things to be desired. The experimental data of Torocheshnikov and Levius[24] are the only data covering the full range of nitrogen concentration. Experimental data of Stutzman and Brown cover a rather narrow range in nitrogen concentration and give equilibrium constants for methane and nitrogen with natural gas as a solvent. This latter fact may be the cause for some of the variation from the data of Torocheshnikov and Levius.[24] The most severe test for a set of equilibrium constants comes in the estimation of bubble points for mixtures of liquefied gases or estimation of equilibrium condensation when the condensate is a large portion of the feed gas.

It is thought that these data are satisfactory for computing the equilibrium number of plates required to effect a given separation. Estimation of bubble and dew points in somewhat doubtful for mixtures of nitrogen and methane as illustrated by the variance in data shown on Fig. 1.

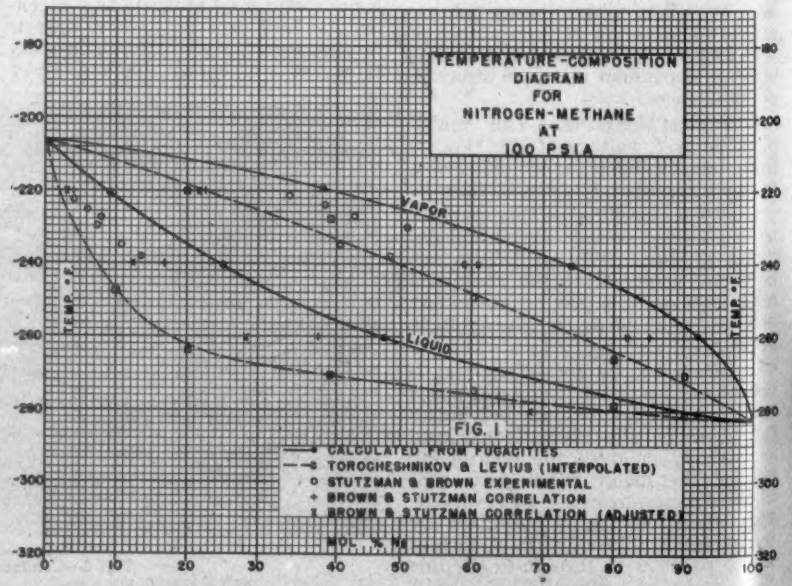

FIG. 1

However, in cases where relatively pure methane is produced from the fractionating tower, the tower bottom temperature will approach rather closely the boiling point for pure methane. This applies to tower-top temperatures when relatively pure nitrogen is produced from the column.

It should be pointed out that temperature levels for intermediate compositions may vary within limits since the temperatures of gases leaving the process are in heat-transfer relationship with gases flowing into the process.

Heat Exchange

Previous discussion of air-separation processes showed that they depend on the ability to pass air through the liquid state, following which nitrogen is separated from oxygen. This process was shown to be accomplished by interchange of heat from the incoming warm-air stream to outgoing colder streams and the supply of sufficient refrigeration to the system to offset heat leakage into it. The transfer of heat between hot and cold streams is relatively easy for air-separation processes because specific heats and boiling points are relatively close together for the major component in the air stream. This is not true with regard to the components present in natural gas.

From the first and second law of thermodynamics it is clear that the

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following two conditions must be satisfied[8] for all heat exchangers in the system.

$$\text{Lb. A } (\Delta H_A) + \text{Lb. B } (\Delta H_B) + Q = O$$

where

H_A = enthalpy component A.
H_B = enthalpy component B.
B = flow of heat into or out of system.

For an exchange in which component A is receiving heat the following inequality in all parts of the exchanger must be satisfied.

$$T_B > T_A$$

These facts make a complex problem of heat transfer between two streams which are vaporizing and condensing under equilibrium conditions. Fig. 2 gives a calculated history of two streams as shown passing through a heat exchanger in a nitrogen-removal plant. It is apparent from the figures that a close analysis of such exchangers is required to insure against temperature crosses and to determine pinches.

Sources of refrigeration for air-separation plants were discussed earlier in this paper. All of these sources are available for effecting the separation of nitrogen from natural gas. Refrigeration must be sufficient to cover net flow of heat into the system by process streams, flow of heat through insulation, and losses due to friction between flowing fluids and equipment within the system.

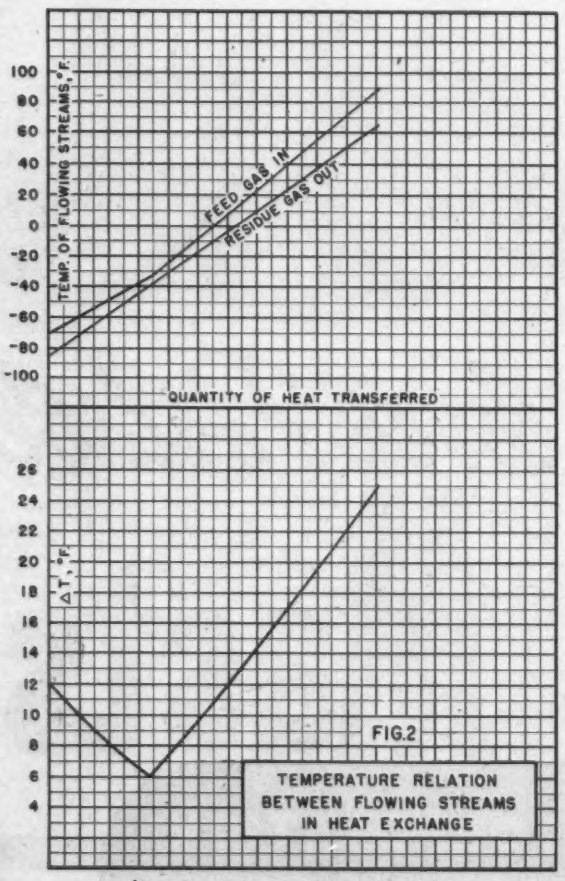
Flow of heat into the system is reduced to a small quantity by close approaches in temperature between temperature of incoming and outgoing gases. Heat leak through insulation is controlled through design which reduces volume of equipment to a minimum. Refrigeration required by well-designed small air-separation plants varies between 4-6 B.t.u. per pound of air[13] flowing into the plant. Refrigeration requirements for large installations can be considerably reduced from this figure.

Prime sources of refrigeration for carrying out the separation of nitrogen from natural gas are:

1. Joule-Thomson expansion.
2. Use of expansion engine.

Joule-Thomson expansion may be used to cover a part of the refrigeration requirement. Unfortunately the extent to which it is used is dictated by the heat-exchange system referred to earlier. In other words the returning processed gas streams must be reduced in pressure sufficiently to provide suitable working temperature difference in all parts of the heat-exchange system.

Joule-Thomson refrigeration in the case of some nitrogen separation plants may be considerable since the petroleum hydrocarbons deviate considerably from the perfect-gas laws and cool considerably on adiabatic expansion. An example based on a mixture of nitrogen and methane is presented; the figures presented in Table 1 which were computed from the process as outlined in Fig. 3 indicate that the warmer steam is carrying a net of 238 B.t.u. into the process per 1,000 cu. ft. of gas feed. This heat must be removed by other means of refrigeration within the process or it must be supplied by precooling of the gas stream. The figures also indicate the importance of close approaches at the warm end of the exchanger.



Heat can be extracted from process streams through use of an expansion engine. Development of equipment of this nature was accelerated in the United States during the war and development work is continuing. References in the literature,[9,10,11,12,13] and experience in operation indicate that the efficiency of these machines is approximately 70 per cent when proper conditions for their operation obtain.

Advantages to be gained in the use of the expansion engine lie in the fact that this operation approaches a reversible process while the throttled expansion of a gas through a valve is highly irreversible. The expander extracts heat from the system and converts the heat energy to mechanical energy. A comparison of initial and final states for an adiabatic expansion through a valve and an adiabatic expansion through a present-day expansion engine will be helpful in evaluating the importance of the expansion engine in low-temperature operations.

	Expansion engine	Expansion through a valve
Gas expanded	N_2	N_2
Initial pressure, psia.	100	100
Final pressure, psia.	20	20
Initial temperature, °F.	—220	—220
Final temp. est., °F.	—284	—232
Heat removal/lb. N_2, B.t.u.	14	0

Nitrogen-separation plants will vary in design according to the conditions of the feed gas and the condition of the products desired. Gas entering the plant will generally be available at pressures between 40 and 600 psig., with nitrogen concentrations between 10 and 30 per cent. The gas will generally have passed through a previous step for removal of natural gasoline but still contains a considerable quantity of propane and butane. The latter are valuable products and their recovery may be easily effected during the course of the nitrogen-removal process.

The nitrogen-free product from the plant may be at low pressure if it is to be used for chemical-plant feed such as to a carbon-black plant or for synthesis-gas manufacture. The amount of nitrogen which may be economically left in this product will also vary according to the use to be made of it. The nitrogen stream leaving the separation plant may be at atmospheric pressure if it is to be thrown to the atmosphere. The separation process is made considerably easier if the nitrogen stream contains considerable methane. However, in such cases, the quantity of methane is usually too large to be wasted and the high nitrogen stream must find use as a fuel gas. Part of it may be utilized in the nitrogen-separation plant as engine fuel.

Fig. 3 illustrates, in simplified flowsheet form, a plant designed for the removal of nitrogen from a gas con-

taining 18.2 per cent nitrogen. Three product streams designated as product gas, raw L.P.G., and residue gas leave the plant. The quantities of these product streams per 1,000 standard cubic feet of feed gas and their compositions are shown on the quantity balance, Table 1, accompanying the flow sheet.

The product gas contains 3.6 per cent nitrogen and has a heating value of 1,008 B.t.u. per cubic foot compared with 935 B.t.u. per cubic foot for the feed gas. The raw L.P.G. stream contains over 97 per cent of the propane and heavier which entered in the feed gas. However, it also contains a high percentage of methane and ethane which must be removed along with a small quantity of nitrogen. Ninety per cent of the nitrogen contained in the feed stream is removed in the residue gas. The residue gas is to be used as a fuel gas and contains 56.7 per cent methane.

The method of separation into the above-mentioned streams may be followed on the flow sheet, Fig. 3. Feed gas enters the separation plant at 315 psig., and 90° F., after previous treatment for removal of water vapor and acid gases. The feed is cooled to —40° F., by products leaving the plant through exchanger E-1. At this point liquid condensed from the feed is separated and the gas is further cooled in exchanger E-2 to —140° F., where a second liquid fraction is separated. The second liquid fraction is combined with the first; the combined stream is throttled to lower pressure and passed back through exchangers E-2 and E-1 helping to cool incoming feed and emerging as a gas at 55 psig., and 65° F.

The portion of the feed stream still in the gaseous state at —140° F., is further cooled by product gas and residue gas leaving the plant through exchangers E-3 and E-4 respectively and then passes through the reboiler E-5. The feed stream leaving E-5 is at — 200° F., and largely liquid. The uncondensed portion is separated and joins residue gas leaving the plant. The liquid portion is throttled and fed to the top of the fractionating column T-1 which operates at 115 psig.

Processing

The liquid fed to T-5 is stripped of nitrogen by a rising vapor stream and on reaching the base of the fractionating column is essentially pure methane. This methane liquid is boiled at the base of the column serving to condense incoming feed. A portion of the reboiled methane leaves the column as product gas and the remainder rises through the fractionating column to act as stripping vapor. Product gas leaves the separation plant through exchangers E-3, E-2, and E-1, serving to cool incoming feed and emerges at 100 psig. and 65° F.

Residue gas leaving the top of the fractionating column, T-1, is heated by incoming feed in exchanger E-4 and then passes through the expansion engine P-1 and out through exchangers E-2 and E-1 emerging at 5 psig., and 65° F.

By performing work through the expansion engine, P-1, the temperature of the residue is reduced and heat is removed from the system. The quantity of heat removed is 1.14 B.t.u. per standard cubic foot of residue gas passing through the expander and, as shown on the heat balance accompanying the flow sheet, the quantity of heat removed by the expansion of residue in the expansion engine must equal the heat brought into the plant by feed gas at 90° F., less the heat removed in product gases at 65° F., plus the heat leaking into the plant from the atmosphere.

The power requirements for the separation process represented in Fig. 3 are calculated as the work required to recompress the product gas and the raw L.P.G., gas from the pressure at which they leave the plant up to 315 psig., the pressure at which they entered in the feed gas. These figures based on 1,000 standard cubic feet of feed entered the plant are tabulated under "Power Requirements" in Table 1 and show 0.78 and 0.29 hp.-hr. for compressing product gas and raw L.P.G., gas respectively to 315 psig. In the case for which this design is set up, it would be necessary to compress the residue gas to a pressure of about 20 psig. since it is to be used as fuel, in which case 0.34 hp.-hr. additional are required for residue-gas compression and the power requirements would total 1.41 hp.-hr. per 1,000 standard cubic feet of feed gas treated.

The process just described removes nitrogen from a stream of natural gas but the nitrogen stream leaving the plant contains 56.7 per cent methane and is to be used as a fuel gas. With 18.2 per cent nitrogen in the feed, the methane in the fuel gas then is 26 per cent of the hydrocarbons in the feed gas to the plant. In most cases it will be difficult to find a use for such a large quantity of fuel gas. In these cases the nitrogen leaving the separation plant should contain a minimum of methane. Fig. 4 shows a process for removing nitrogen from natural gas whereby a waste stream containing only 10 per cent methane is produced. Thus the amount of methane carried out in the waste nitrogen stream is only 2.2 per cent

TABLE 1—MATERIAL BALANCE

	Treated feed gas		Product gas		Raw L.P.G.		Residue gas	
	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent
N_2	182	18.2	18	3.6	0.8	0.6	163.2	43.3
C_1	723	72.3	460.2	92.5	50	39.5	212.8	56.7
C_2	61	6.1	19	3.8	42	33.3	....	....
C_3+	34	3.4	0.5	0.1	33.5	26.6	....	....
	1,000	100.0	498	100.0	126	100.0	375	100.0
H.H.V. at 60° F.								
B.t.u. per cu. ft.	936		1,008		....		....	
Gal. of C_3 and hvr.	0.970		....		0.954		....	

HEAT BALANCE

	B.t.u.
Heat in with feed	16,950
Heat out with products	16,712
Net in	238
Heat leak	190
Total heat into plant	428
Heat removed by expander	428

POWER REQUIREMENTS

	Hp.-hr.
Product, 100 to 315 psig.	0.78
Raw L.P.G., 55 to 315 psig.	0.29
Residue, 5 to 20 psig.	0.34
Total product to 315 psig.	1.41
Maximum recovery from expander	0.32

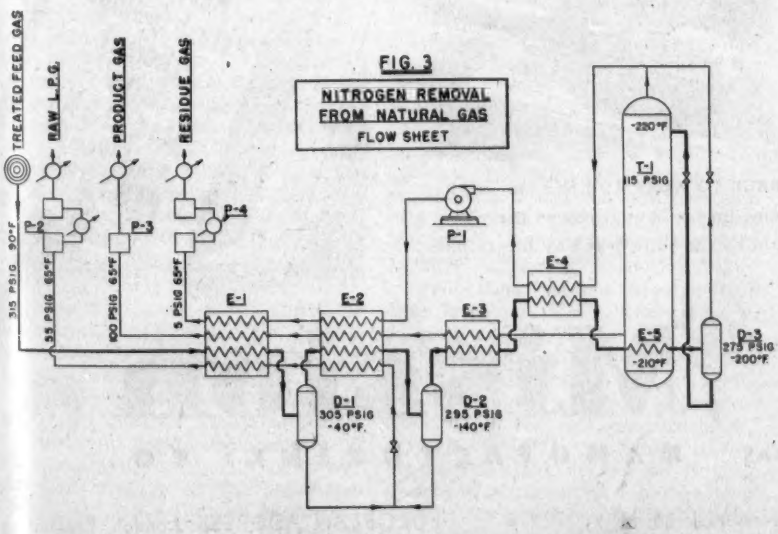
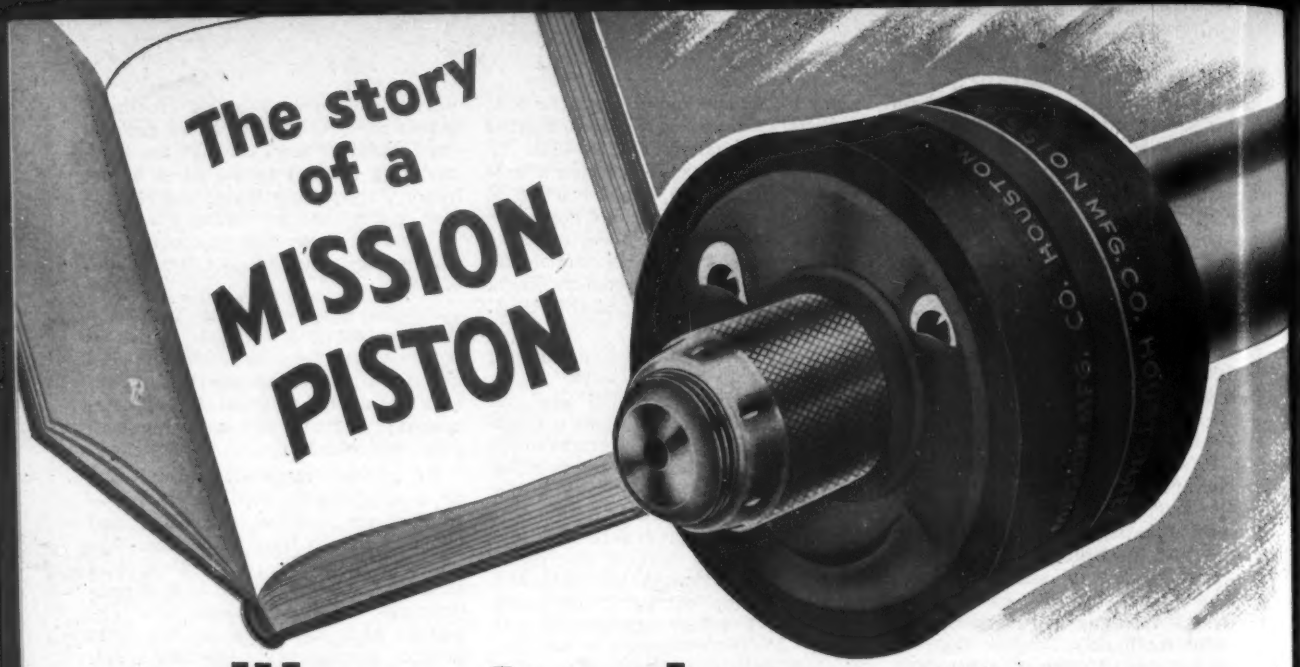


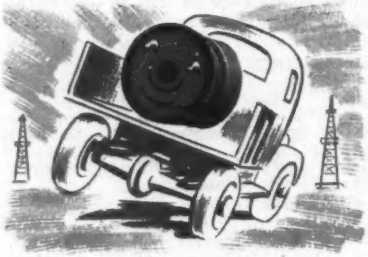
FIG. 3
NITROGEN REMOVAL FROM NATURAL GAS
FLOW SHEET

The story of a MISSION PISTON

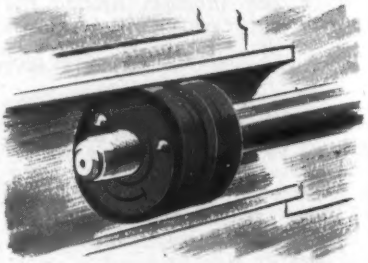


or "how I reduce PUMP UPKEEP COSTS"

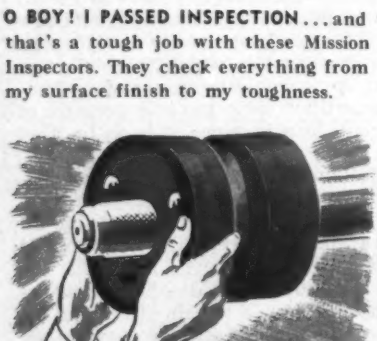
O BOY! I PASSED INSPECTION... and that's a tough job with these Mission Inspectors. They check everything from my surface finish to my toughness.



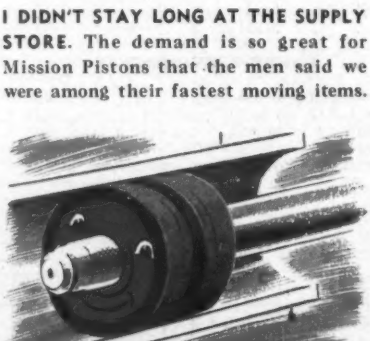
I DIDN'T STAY LONG AT THE SUPPLY STORE. The demand is so great for Mission Pistons that the men said we were among their fastest moving items.



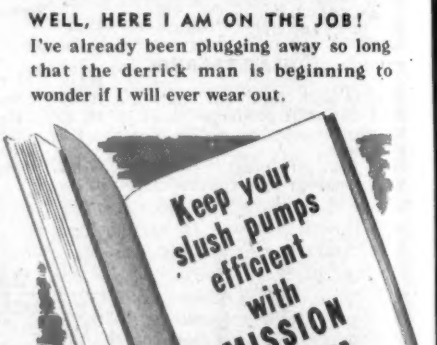
WELL, HERE I AM ON THE JOB! I've already been plugging away so long that the derrick man is beginning to wonder if I will ever wear out.



DON'T GET EXCITED . . . I'M NOT GONE YET! I'll be as good as new when my rubbers are changed. Notice that they don't even have to take me off the rod to change my rubbers.



BACK TO WORK AGAIN. I may not have nine lives . . . but I have so many that I am by far your best buy in pistons.



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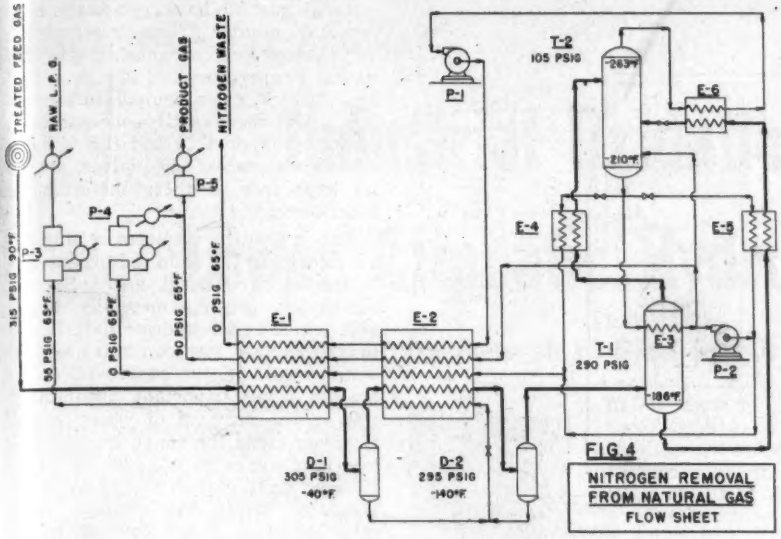

FIG. 4

NITROGEN REMOVAL FROM NATURAL GAS FLOW SHEET

TABLE 2—MATERIAL BALANCE

	Treated feed gas		Product gas		Raw L.P.G.		Nitrogen waste	
	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent
N_2	182	18.2	18	2.6	0.8	0.6	163	90.0
C_1	723	72.3	655	94.6	50	39.5	18	10.0
C_2	61	6.1	19	2.7	42	33.3	....	....
C_3+	34	3.4	0.5	0.1	33.5	26.6	....	....
	1,000	100.0	693	100.0	126	100.0	181	100.0
H.H.V. at 60° F.								
B.t.u. per cu. ft.	936		1,010		....		....	
Gal. of C_3 and hvr.	0.970		....		0.954		....	

HEAT BALANCE

	B.t.u.
Heat in with feed	16,950
Heat out with products	16,797
Net in	153
Heat leak	181
Total heat into plant	334
Heat removed by expanders	334

POWER REQUIREMENTS

	Hp.-hr.
Product, 0 to 90 psig.	1.61
Product 90 to 315 psig.	1.08
Raw L.P.G., 55 to 315 psig.	0.29
Total product to 315 psig.	2.98
Maximum recovery from expander	0.24

of the hydrocarbons in the feed gas.

Referring to Fig. 4 it may be seen that the incoming feed is cooled and heavy hydrocarbons separated out in a manner similar to that described above for the flow sheet on Fig. 3. In this case, however, the feed gas leaving the exchanger E-2 and separator D-2 enters the base of the rectification tower, T-1. A preliminary separation of the feed takes place at 290 psig. in T-1; overhead vapors contain about 60 per cent nitrogen and bottom liquid about 10 per cent nitrogen. The overhead vapors are condensed in the exchanger E-4 and reflux the column T-2 which operates at 105 psig. The bottoms liquid from T-1 is cooled in exchangers E-5 and E-6, and fed to T-2.

The overhead vapors from T-2 waste gas, containing 10 per cent methane, are heated in E-6 and then pass through the expansion engine P-1 to furnish part of the refrigeration required in the separation plant.

Liquid from the base of T-2, essentially pure methane, splits into several different streams; one stream of liquid methane serves to condense reflux at the top of the rectifying tower, T-2, and is thereby vaporized. Part of the methane thus vaporized leaves the plant via the main heat exchangers E-2 and E-1 and emerges as product gas at 65° F. and 90 psig.; the remaining vapor passes through the expansion engine P-2 to furnish additional refrigeration since the quantity of waste gas passing through expander P-1 is not large enough to furnish the entire refrigeration requirement. Liquid methane also serves to condense reflux liquid for T-2 and to cool liquid feed to T-2 as it boils at reduced pressure in exchangers E-4 and E-5 respectively. Methane vapors from E-4 and E-5 are combined with exhaust gas from expander P-2 and the entire stream passes through the main exchangers E-2 and E-1, emerging from the plant as product gas at 65° F., and 0 psig.

Product gas, leaving the plant at 0 psig. is compressed in two stages to 90 psig. and combined with product gas leaving the plant at 90 psig. The total product stream is then compressed in one stage from 90 psig. to the original feed-gas pressure of 315 psig. Raw L.P.G., recovered in the separation plant, leaves at 55 psig. and is also compressed to 315 psig. The power required for these operations is 2.98 hp. per 1,000 standard cubic feet of feed gas treated.

A material and heat balance for the process just described is given in Table 2.

The two schemes just proposed for separation of nitrogen from natural gas produce byproducts gas containing in the first case about 57 per cent methane, and in the second case 10 per cent methane. It may be important to produce a nitrogen waste free of methane at the penalty of increased separation cost over the former cases.

A scheme proposed for the removal of 90 per cent of the nitrogen from a natural gas containing 18.2 per cent nitrogen, and at the same time producing a waste gas containing no more than 1 per cent methane is outlined on the schematic flow sheet Fig. 5 and described below.

Cooling and condensation of the natural gas with recovery of the propane and heavier fraction are carried out in the same manner as in the other nitrogen-removal processes described previously. Natural gas condensed in the reboiler of the fractionating column is, however, introduced to the fractionating column at an intermediate point as a liquid feed and the uncondensed portion, as a vapor feed.

In order to produce pure nitrogen overhead from the fractionating column, pure nitrogen liquid must be supplied to the top of the column as reflux. This nitrogen reflux is obtained from a circulating stream of nitrogen which leaves the compressor P-4 at 1,200 psig. The compressed nitrogen is cooled successively in the heat exchanger E-5 by cold nitrogen gas, in the reboiler E-6 by boiling methane, in the exchanger E-7 by tower overhead gas, and finally in the exchanger E-8 by expander exhaust gas. The compressed nitrogen gas is cooled to such an extent at this point that when its pressure is reduced to the operating pressure of the fractionating column, 115 psig. in this case, a considerable portion is obtained as liquid in separator D-4, and flows into the fractionating column as reflux.

Uncondensed nitrogen from D-4 joins the pure nitrogen gas leaving the top of the fractionating column. The entire nitrogen stream then cools incoming compressed nitrogen in the exchanger E-7. A portion of the nitrogen passes through the expansion engine E-7 to furnish refrigeration to the plant. The portion not required for refrigeration partially cools incoming compressed nitrogen in the exchanger E-5 and enters as intermediate compression stage of the compressor P-4 to be recompressed to 1,200 psig. and complete its cycle. Expander exhaust nitrogen performs the final cooling of incoming compressed nitrogen in exchanger E-8

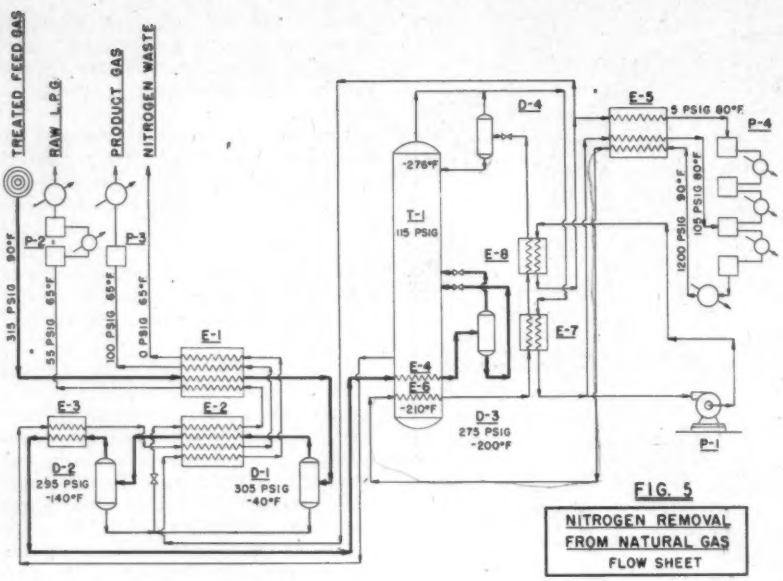

FIG. 5

NITROGEN REMOVAL FROM NATURAL GAS FLOW SHEET

TABLE 3—MATERIAL BALANCE

	Treated feed gas		Product gas		Raw L.P.G.		Nitrogen waste		Circulating nitrogen	
	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent	S.c.f.	Per cent
N_2	182	18.2	18	2.5	0.8	0.6	163	99.0	662	99.0
C_1	723	72.3	672	94.7	50	39.5	1.6	1.0	7	1.0
C_2	61	6.1	19	2.7	42	33.3	....	....	....	....
C_3+	34	3.4	0.5	0.1	33.5	26.6	....	....	....	....
	1,000	100.0	710	100.0	126	100.0	164	100.0	669	100.0
H.H.V. at 60° F. B.t.u. per cu. ft.	936		1,010		....		....		....	
Gal. of C_3 and heavier	0.970		....		0.954		....		....	

HEAT BALANCE

	B.t.u.
Heat in with feed	16,950
Heat out with products	16,706
Net in	244
Heat leak	285
Total Heat into plant	529
Net heat removed by circ. nitrogen	181
Net heat into plant	348
Heat removed by expander	348

POWER REQUIREMENTS

	Hp.-hr.
Product, 100 to 315 psig.	1.12
Raw L.P.G., 55 to 315 psig.	0.29
Circ. nitrogen, 5 to 1,215 psig.	2.36
Circ. nitrogen, 100 to 1,215 psig.	0.91
Total product gases to 315 psig.	4.68
Maximum recovery from expander	0.26

and then splits into two streams; the first, representing nitrogen removed from the natural gas, partially cools incoming natural gas in the exchangers E-2 and E-1 before leaving the plant; the second, representing part of the circulating nitrogen stream, partially cools incoming compressed nitrogen in the exchanger E-5 and then is compressed in P-4 to 1,200 psig. completing its cycle.

Quantities of various streams based on 1,000 standard cubic feet of natural gas entering the plant are shown in Table 3.

Refrigeration is obtained, in this scheme, from two sources: (1) expansion of nitrogen through the expansion engine and, (2) Joule-Thomson cooling from the circulating nitrogen stream compressed to 1,200 psig. and returned at low pressures. The heat balance for the process is outlined in Table 3.

The power requirements for the process are shown in Table 3. The total power required for recompressing product methane gas and raw L.P.G., to 315 psig. is 1.41 hp-hr. and the power for compressing nitrogen in the recirculating nitrogen stream, 3.27 hp.-hr. for each 1,000 standard cubic feet of natural gas processed. This power requirement is high and, while it might be reduced to a certain extent by measures such as forecooling of the 1,200-psig. nitrogen stream, it is doubtful that the entire quantity of nitrogen removed may be taken off as pure nitrogen economically. Either methane must be discarded to the extent of 10-20 per cent of the nitrogen stream or utility as fuel found for an effluent stream of relatively high nitrogen content.

Natural gases usually contain CO_2 in measurable amount and in some cases high concentration. Many contain more or less H_2S. All natural gas contains water vapor and in nearly all instances is saturated. These three common impurities in natural gas all have relatively high freezing points. Efficient separation of nitrogen from natural gas requires temperatures as low as —260° to —300° F. Such temperatures permit only very small concentrations of water vapor, CO_2 and H_2S if heat-transfer surfaces and valves are to be kept free of these materials in solid form.

The literature discloses a number of references to solid adsorbent dehydration of natural gas.[16] Several adsorbents are commercially available which can dehydrate natural gas to exceedingly low concentrations of water vapor. Solid adsorbent dehydration is an important preliminary step in the removal of water vapor. However since the range in dehydration is of the order of —20° to —100° F., dew point, other means must be taken to insure the removal of a small residual water content which is not removed in the external dehydration equipment.

The removal of hydrogen sulfide has occupied the artificial gas industry for many years. Hydrogen sulfide removal from natural gas has been more important in the last decade because gas fields holding natural gas which is free of hydrogen sulfide have been depleted. Removal of H_2S has been easily accomplished through the use of amine solutions.[5] A large number of this type of plant have been built which have been described in the literature.[15] Solutions of monoethanolamine are usually used to effect the removal of H_2S because this amine is more strongly alkaline and therefore removes hydrogen sulfide more efficiently than either di or triethanolamine. Carbonic acid is a stronger acid than is hydrogen sulfide and this acid gas constituent is, therefore, efficiently removed from the gas stream along with the hydrogen sulfide. Experience in operation indicate that H_2S and CO_2 can be removed to concentrations of approximately 0.1 grain per 100 standard cubic feet of gas.

Reference to Fig. 6 indicates the concentrations of water vapor, hydrogen sulfide, and carbon dioxide which will saturate a gas stream at the indicated temperature and 14.7 psia. Concentrations permissible at pressures higher than atmospheric will vary approximately inversely as the absolute pressures. If the concentration of CO_2, H_2S or water vapor is higher than the saturation concentration, liquid or solid phases of these components will precipitate.

Materials of Construction

The choice of materials of construction for low-temperature service requires special consideration. While the tensile strength of carbon steel, steel alloys, and nonferrous metals increase with decreasing temperature,

(Continued on page 112)

Some Aspects of the

Industrial Oxidation of Lower Aliphatic Hydrocarbons

by Joseph E. Bludworth

HOW much you sell hydrocarbons for is what determines gross revenue. Instead of dollars per barrel, or cents per thousand cubic feet, petroleum-and-natural-gas-derived chemicals sell by the pound, and command the highest prices of any of the industry's products. Thus "petrochemistry" constitutes the No. 1 upgrading of our industry's raw materials.

The author, petroleum and chemical consultant with offices in Corpus Christi and Houston, described another operation in this same activity in the January 1, 1948, Journal, "Engineering Completed for New $15,000,000 Petrochemical Plant to Be Built on Gulf Coast."

THE oxidation of hydrocarbons derived from natural gas forms an important basis for many industrial reactions. Among the more important chemicals derived from the direct oxidation of gaseous hydrocarbons are acetaldehyde, formaldehyde, propionaldehyde, methanol, ethanol, proponal, acetone, and acetic acid. The industrial importance of direct oxidation is borne out by the fact that Cities Service Oil Co., at Tallant, Okla., produces substantial amounts of methanol, formaldehyde, and acetaldehyde from the direct oxidation of methane, ethane, and propane.[1] Also, Celanese Corp. of America has built a $20,000,000 plant for the partial oxidation of 15 billion cubic feet per year of natural gas.[2]

The vast quantities of hydrocarbons available in crude petroleum and in natural gas offer a source of materials for organic synthesis at relatively low cost. Such possibilities, inherent in oxidation which might convert hydrocarbons to oxygen-bearing substances of commercial value, make the study of such operation of importance. As an example of the possibilities in this field, Egloff and Schaad[3] in 1929 calculated from the amounts of the various paraffin hydrocarbons in commercial fuel gases that 2 trillion cubic feet per year of methane, ethane, propane, and butane are available for conversion into oxidation products. It has been estimated that, if this oxidation could have been carried through to the production of alcohols, it would have resulted in the theoretical production of some 30 billion gallons of methyl, ethyl, propyl, and butyl alcohols.[4]

If, in 1929, the importance of these reactions was seriously being considered, the situation today is three or four times as great. The natural-gas reserves in the United States have now increased to the point that they are approximately 160 trillion cubic feet, almost 400 per cent more than the amount available in 1930.

The mild oxidation of aliphatic hydrocarbons yields, as principal products, methanol, formaldehyde, acetaldehyde, and acetone, as well as smaller quantities of acids, higher alcohols, and aldehydes. The amounts of each of these oxygenated products vary as to the type of hydrocarbon used, as well as the operating conditions employed for oxidation. Table 1 lists the principal oxygenated products of the lower aliphatic hydrocarbons in their order of decreasing yields.

TABLE 1

Hydrocarbon	Oxygenated products* in order of decreasing yields
C_1	2, 3
C_2	3, 2, 1,
C_3	1, 3, 2, 4
n-C_4	1, 3, 2, 4
i-C_5	4, 1, 3, 2

*Key to Table 1: (1)—Acetaldehyde. (2)—Methanol. (3)—Formaldehyde. (4)—Acetone.

When it is considered that the vapor phase-oxidation of hydrocarbons can (at least theoretically) produce any of the various intermediates before reaching the ultimate end products, carbon dioxide and water, it is not surprising that various investigators have claimed the production of one or more of these chemicals from hydrocarbon oxidation. However, instead of many possible products being a stimulant to the commercial production of oxygenated compounds, it has actually resulted in the hindering of the commercial progress.

What we might term "incidental" exploration of the reaction has too often led to interpretations completely foreign to the best practices necessarily employed for producing desired end products. This is probably best illustrated by the evident analogy in the procedures employed. For example, the usual means of oxidizing methane is by using a so-called oxidation catalyst, the most commonly employed being copper or copper-bearing compounds. While copper may be a fairly good catalyst for effecting the oxidation of methanol to formaldehyde, the assumption that it will be superior for methane oxidation is not based on a clear understanding of the kinetics of the reaction nor the stability of the products resulting from oxidation.

In not all instances has the study of catalysts been the only source of misinterpretation. In many instances, investigators have elaborated upon results derived through long periods of heating and exposing reactants and products to severe operating conditions. In terms of industrial oxidation these results mean nothing. It is apparent that such approaches could lead only to low yields of desired products and would promote the formation of the end products, carbon oxides and water. Other products obtained by such means would be characterized by extreme stability or would be equilibrium products. The most desired products obtained commercially are not characterized by either of the above properties.

Probably, as a result of the above mentioned reasoning, the commercial aspects of the direct oxidation of the lower aliphatic hydrocarbons have languished. In the years from 1898 to about 1925 there seems to be little to indicate much progress from the commercial point of view. Actually, in 1925, only 0.1 per cent of the synthetic aliphatic organic chemicals produced in the United States were derived from petroleum. Investigators and their results seem to have played only a small part in the development of the first commercial hydrocarbon

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oxidation unit. This was built by Cities Service Oil Co. at Tallant, Okla., in 1926 and was an outgrowth of attempts to render corrosive oxygen-bearing natural gases noncorrosive. This plant was an important step forward in the commercial oxidation of hydrocarbons.[5,6,7]

Cities Service Oil Co. has been the pioneer in the direct oxidation of the lower paraffin hydrocarbons to valuable oxygenated chemicals. J. C. Walker and his associates discovered in 1925 that the corrosion of pipe lines caused by gas containing free oxygen could be minimized by bringing the gas to the necessary temperature and pressure to permit the oxygen present to be completely used up by reacting with the hydrocarbons. The formation of liquid oxygenated chemicals accompanied this reaction. The first commercial plant using an oxidation process of this type was constructed at Tallant, Okla., in 1926. This plant has been expanded and three additional oxidation plants have been built.

Direct partial oxidation of hydrocarbons can be carried out with or without a catalyst by heating air in admixture with an excess of hydrocarbons to a temperature where the oxygen is consumed.

Celanese Corp. Operations

The operation of the Celanese Corp. oxidation plant at Bishop, Tex., as can be seen from the patent literature, makes a great forward step in control of the oxidation reaction by using various agents for this purpose. Some of these agents for controlling reactions are deluting steam, nitrogen, and other such inert gaseous materials.

While the claims of the Cities Service patents deal with the oxidation of methane, ethane, propane, and butane, Celanese Corp.'s claims are largely based on higher hydrocarbons than methane.

The importance of this industry can best be illustrated by the fact that Celanese Corp. at the present time is one of the largest producers of methanol and formaldehyde. Also, it might be pointed out that in 1945 the production of organic aliphatic chemicals from petroleum had been increased to 50 per cent, whereas in 1925 it was only 0.1 per cent.

Many patents too numerous to mention have been issued claiming yields of oxygenated chemicals from hydrocarbons by the above procedure in some modified form. Most of these processes are very similar, yet employing various hydrocarbons in admixture with air which are generally passed over a catalyst bed. Among the catalysts which have been used are iron, nickel, copper, silver, gold, patinum, palladium, vanadium, chromium, molybdenum, manganese, their oxides, mixtures of their oxides, mixtures of the oxides and metals, aluminum sulfate, and alkyl ethers. This list is not intended to be complete, but only to show that quite a formidable array of catalysts have been suggested.

From the experimental results obtained, it would seem that the first investigators of the oxidation of hydrocarbons were probably more familiar with the normal procedure for petroleum processing for the production of gasoline than for the production of heat-sensitive organic compounds. As might be expected, some of the same techniques were used in the oxidation that were used in the art of cracking.

Reaction Mechanisms

Up until recent years the art of cracking depended primarily upon sufficient control of time and temperature in order that a product might be derived which would fall in a predetermined wide boiling range. It is quite true that the cracking processes, so developed, produced this broad-boiling-range product with the least amount of loss to fixed gases and carbon. Actually, it has not been until very recently that the need for extremely close control of the cracking reaction has been required. This exacting attention to heat rise at the point of instability of the cracking feed stock was brought about by catalytic cracking. Any unusal temperature rises would result in short cycles of operation and increased cost of processing.

With the very latest processes for catalytic cracking for the manufacture of gasoline and allied products, temperature control has become of even more importance, and the units are so designed that at all times a most rigid control is exercised over the temperature in the catalyst beds. If the first hydrocarbon oxidation had followed the latest technique in petroleum cracking, in all probability its development as an industry would have been far more rapid, since the value of close control of reaction temperature is many times more important in oxidation than it could possibly be in the cracking operation.

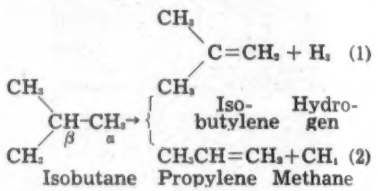
While it may be none too difficult to appreciate, we would like to illustrate, by use of the reaction mechanism and its close analogy to pyrolysis, the necessity of close temperature control during hydrocarbon oxidation.

It can be remembered that the yield distribution of various products shown in Table 1 varies widely with the hydrocarbon employed. The most marked variations in yield are for methane (which produces only methanol and formaldehyde) and isobutanes. The isobutanes yield substantial amounts of acetone in contrast to the other hydrocarbons. In fact, the whole degree of yields is different from those of the other hydrocarbons.

These variations in yield can be explained on the basis of the predominant bond scissions of the hydrocarbon employed. To arrive at the predominant bond scissions encountered in oxidation, the pyrolysis data of the hydrocarbon can be studied.

Regardless of the reaction mechanism involved, or the hydrocarbon radical in question, it is reasonable to believe that the degradation of hydrocarbon molecules and the position at which the reacting radicals attack the molecules is governed by the same factors that govern their degradation and point of attack during thermal pyrolysis.

For example, the pyrolysis of isobutane in the lower range of pyrolytic temperatures yields propylene, methane and isobutylene according to the following reactions:

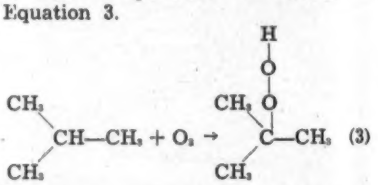


Isobutane Propylene Methane

These two reactions amount to 85 to 95 per cent of the reactions during low-temperature pyrolysis of isobutane.

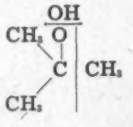
The bond scissions predominating in pyrolytic cracking represent the weakest bonds in the molecule. These same bonds respond most readily and in corresponding degrees to oxygen.

In Reaction 1 two carbon-hydrogen linkages are ruptured in the alpha and beta positions to give hydrogen and isobutylene. This bond rupture is analagous to the oxidation mechanism where the carbon-hydrogen group on the beta carbon is ruptured to form a "peroxide" as shown in Equation 3.



Isobutane Oxygen Tertiary butyl hydroperoxide

The "peroxide" shown in Equation 3 disintegrates to a hydroxy radical (which attacks another isobutane molecule starting a chain reaction), a methyl radical, and acetone. The following series of reactions illustrates this:



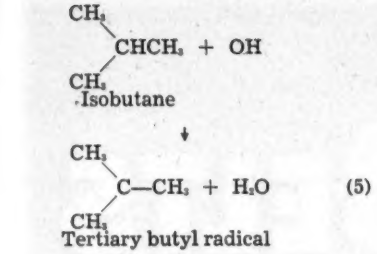
Tertiary butyl hydroperoxide

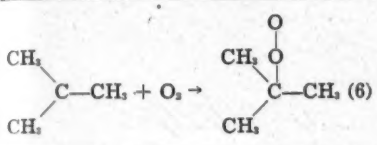
↓

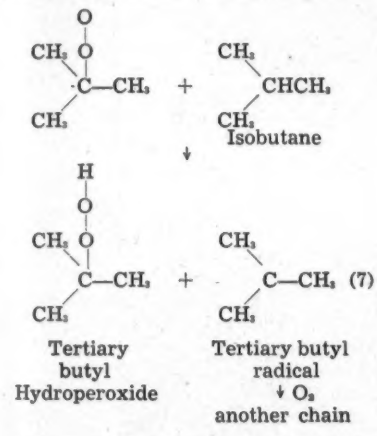
$(CH_3)_2CO + OH + CH_3$ (4)

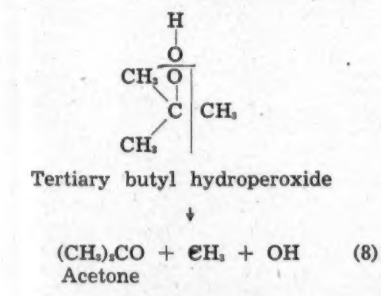
Acetone

The chain reaction is continued as follows:









The methyl radicals (CH_3) produced in Equations 4 and 8 can be oxidized to produce formaldehyde:

$$CH_3 + O_2 \rightarrow CH_3OOH \rightarrow CH_2O + OH \quad (9)$$

Methylene hydroperoxide — Formaldehyde

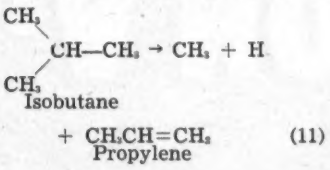
or combine to form, as in pyrolysis, ethane:

$$2CH_3 \rightarrow C_2H_6 \quad (10)$$

Ethane

Going back to Equation 3, it has been shown that the end products of the chain reaction which started with the carbon-hydrogen bond scission produced acetone and formaldehyde. This same carbon-hydrogen scission was also stated to occur in the pyrolysis of isobutane in forming isobutylene, substantiating the analogy between the predominant bond scissions during oxidation and pyroylsis.

Equation 2 requires the breakage of carbon-carbon linkage between the beta carbon and one of the methyl groups and an alpha carbon-hydrogen linkage. Equation 2 can be rewritten:



The methyl radical here, too, can form ethane or formaldehyde as in Equations 9 and 10. The hydrogen can react in one of several ways—three of which are shown in Equations 12a, 12b, and 12c.

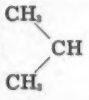
$$2H \rightarrow H_2 \quad (12a)$$

$$H + O_2 \rightarrow OH + O \quad (12b)$$

$$CH_3 + H \rightarrow CH_4 \quad (12c)$$

and either become inert or furnish hydroxyl radicals for the reaction.

If the alpha carbon-hydrogen linkage is attacked by oxygen, it can be shown by similar equations that the end products are again acetone and formaldehyde. The formation of acetone in the scheme involving the rupture of the alpha carbon-hydrogen linkage depends on the intermediate radical of the reaction:



being attacked by oxygen to form a peroxide followed by degradation. However, this radical can alternately rearrange to form propylene.

A series of similar reactions employing propylene produce ketene as a final peroxide degradation product together with a methyl radical and a hydroxyl radical. The ketene, being unstable in the presence of water and under the reaction conditions, yields with water, acetic acid; by thermal decomposition carbon monoxide and methylene radicals; and by polymerization diketene and other polymers. Diketene, if formed, would probably react with water to form carbon dioxide and acetone through the unstable acetoacetic acid. The predominating reaction would, however, be the hydration of ketene to acetic acid. This theory is a heretofore unmentioned mechanism for acid formation during hydrogen oxidation and is to a great extent substantiated by unpublished data which show that acetic acid is the predominant acid formed during hydrocarbon oxidation, even though large amounts of formaldehyde are always produced simultaneously.

Other series of reactions may be written which show the action of the hydroxyl radicals on propylene formed in Reaction 2 to form acetaldehyde and methanol.

The most detrimental factor to good yields of these products is the lack of temperature control over the reaction. In general, the lower the temperature employed, the better the yields. This can be explained by four facts:

1. As the temperature is increased there is another increased tendency for oxygen attack at the more stable bonds in the molecule. Just as in pyrolysis, where the molecule has a greater tendency to split up (eventually to carbon and hydrogen) as the temperature is increased, the degradation of the molecule due to oxygen attack increases with temperature. The result of this increased degradation leads to products of lower molecular weight and increased quantities of fixed gases such as methane and the carbon oxides.

2. Methyl radicals tend to be oxidized too far due to hydroxyl radical attack.

$$CH_3 + OH \rightarrow CH_2 + H_2O \quad (13a)$$

$$CH_2 + OH \rightarrow CH + H_2O \quad (13b)$$

$$CH + OH \rightarrow CO + H_2 \quad (13c)$$

This type of degradative oxidation of methyl radicals (or other radicals) is greatly favored by increased temperatures.

3. Increased temperatures increase the stability of the intermediate peroxy compounds with the result that there is an increased tendency toward "complete" decomposition.

$$CH_3 + O_2 \rightarrow CH_2OOH \rightarrow CO + H_2 + OH \quad (14)$$

4. Fragile aldehydes, produced, as an end product of a chain reaction, tend to decompose to carbon monoxide, hydrogen, and paraffins. This aldehyde decomposition is favored by temperature increases. There is no doubt that acetaldehyde and formaldehyde are extremely sensitive compounds and that their tendency to decompose to carbon monoxide and hydrogen or methane, is greatly accelerated by temperature increases.

Thus, it becomes evident that the proper reaction temperature must be employed and precise control exercised over it.

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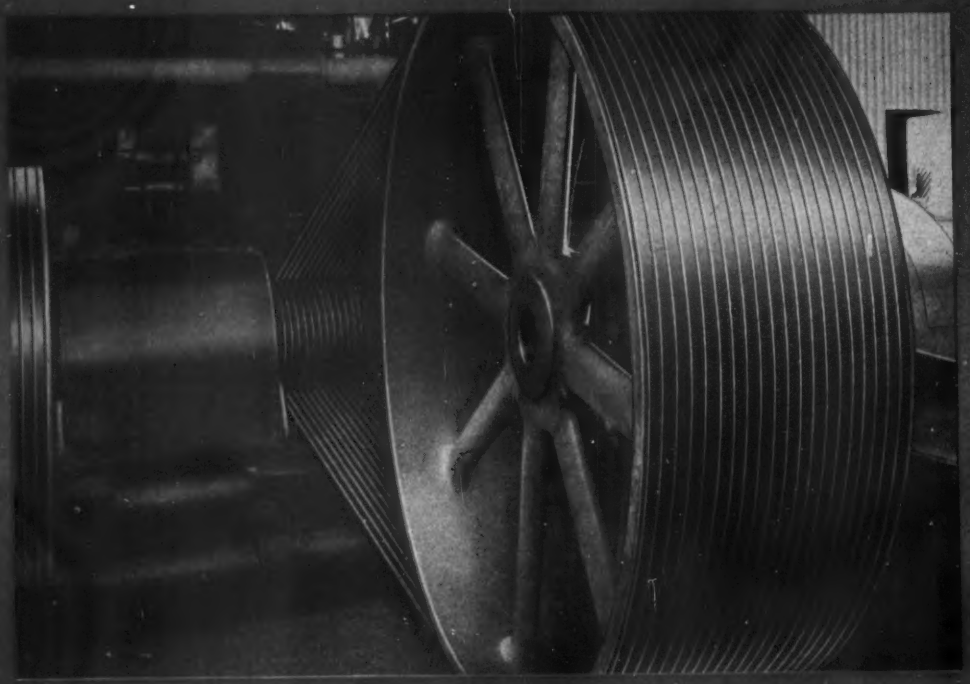

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Zinc Anode Protection

(Continued from page 88)

rent requirements for cathodic protection are determined by two factors: (1) The area of bare pipe, and (2) the amount of current which may be delivered by each grounding anode in the various soils through which the pipe line passes.

TABLE 1

Section	Pipe size (in.)	Miles	Est. percentage of bare pipe	Bare pipe surface in sq. ft. per anode	Anode spacing
1	12	17.8	.2	1.72	300
2	16	29.8	.3	2.59	210
3	16	20.5	.5	3.08	152
4	16	7.5	.8	3.28	100
5	16	0.5	3.0	0.45	45

Anode Distribution

The general agreement among corrosion engineers is that a current of 1.5 ma. will afford adequate protection from corrosion in most soils. By rigid inspection on new lines, exceedingly close estimates may be made of exposed surfaces and by the same token, current requirements for a given length. Table 1 shows the estimated percentage of bare pipe and rod spacings per section and the area in square feet of pipe to be protected by each anode.

The low ratio of bare pipe surface to zinc (Note 1 and 2) takes into consideration the low galvanic voltage between iron and zinc. (0.35 volt), soil resistance, and moisture absorption by the coating with age. For uniform potential distribution on medium diameter lines a separation of 300 ft. should be considered the maximum when zinc is used as the sacrificial metal.

The results of pipe-to-soil potentials, made in July 1946, and May 1947, as measured to a steel exploring electrode, are shown in Fig. 2. The low potentials at the junction are due to the meeting of an unprotected 14-in. line with the main line. From Bayou Courtableau to the Atchafalaya River, no protecting anodes have been installed. This 8 miles of pipe line was floated into place during the 1946 high-water period of the flood basin. Cathodic protection will be completed when the water moves off and the work can be done.

Beginning at a point 1 mile west of the Carey gate and extending to the West Mississippi River Header, painting and wrapping were done in a central yard, as explained earlier in this paper. This refers to Section 4 of Table 1 where rod spacings are 100 ft. Potentials are lower than they should be for protection and the section may require additional anodes at a later date. Section 5 passes through a refinery yard with its network of underground piping, none of which has cathodic protection. Should no protection be applied to these lines, this company may be required to make repairs sometime in the future to its line through this area.

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Spain's Oliana Wildcat Now Down to 7,000 Ft.

The wildcat being drilled on the Oliana structure, in Spain's Lerida province. is down to approximately 7,000 ft., in shale. Projected depth is 8,000 ft.

If no oil is found here, the company, Cia. de Investigaciones y Exploraciones Petroliferas, S.A., plans to move the rig to Burgo de Osma in the province of Soria. *(Details on the formation of this company were published in The Oil and Gas Journal, April 19, 1947, page 69.)*

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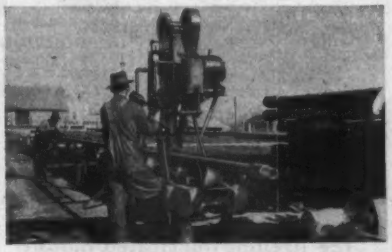
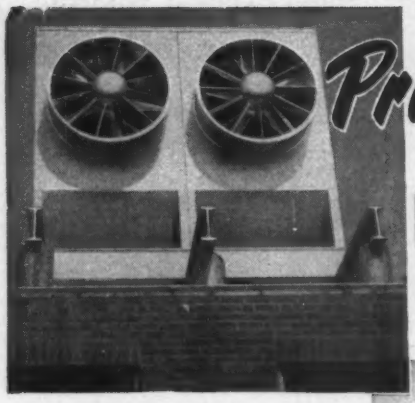
All pipe returned to our yards is steam cleaned and rigidly inspected.



Returned pipe is straightened (above), repaired to first class condition and threads properly lubricated before being replaced on racks.



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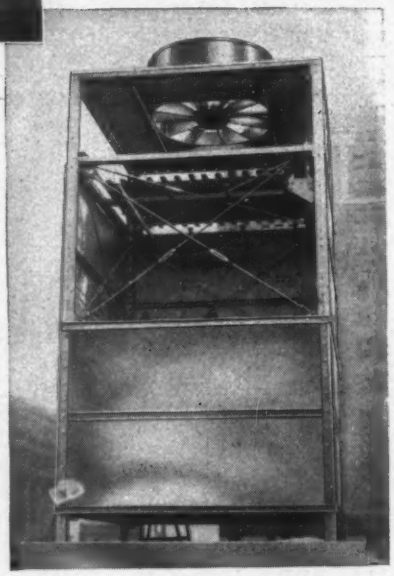

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available in a complete range of capacities for roof or ground installation as standard spray towers, or with coil systems in base for closed system cooling. Offered with or without basins or internal decks. Low pressure water distribution system minimizes pumping cost. Slip-fit louvers lift out easily for access to interior. Simple bolted assembly of Redwood or All-Metal shipped complete, knocked down. No special knowledge, special tools or skilled labor required to install.

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Prospective Acreage in Discovery Expectancy

(Continued from page 83)

during recent years but also reflects upward revisions of previous estimates as well as the purchase of producing properties with crude-oil reserves approximating 30,000,000 to 40,000,000 bbl. Consequently the company's actual discovery efficiency is less than that indicated.

Shell—Opposed to checkerboarding low-cost acreage, Shell's discovery efficiency, like Amerada's, reflects in part a general preference for quality acreage acquired on the basis of thorough geophysical and geological investigation. Despite this indicated efficiency, future prospects are weighted with a low acre-production ratio.

Texas.—Ranking third of the 25 companies in gross oil discoveries during recent years, withdrawals have been correspondingly high with the result that net percentage additions to reserves have been less than the average for other companies. A continuation of this trend is suggested in Table 6.

Houston.—Statistically a lower than average record in the past is also indicated likely to continue in the future, on the basis of this study. While well provided with prospective land, Houston is handicapped by the highly concentrated nature of much of this acreage which deprives it of the benefits normally resulting from the exploratory operations of other companies in areas of diverse ownership.

Companies with large oil reserves in California.—It is of possible interest to note that California companies, with the exception of Superior, are characterized by (1) low reserves of acreage in relation to over-all production, and (2) a high indicated discovery efficiency. These relationships are shown as follows:

Company—	Approx. % of crude reserve located in Calif.	Acres per barrel of prod.	Discovery efficiency
Richfield	100	.048	1.8
Union	80	.030	3.7
Std. California	70	.039	2.6
Honolulu	50	.028	1.9
Superior	50	.216	.9
Shell	40	.050	2.0

The high indicated discovery efficiency of these companies, other than Superior, may possibly be due in large measure to the upward revisions of California reserve estimates between 1940 and 1945, rather than to any outstanding success in finding oil for the group as a whole.

Fig. 1 provides a graphic summary of average annual oil-discovery results for the 25 oil companies in terms of their prospective acreage holdings. Those companies with 40

SOURCES OF INFORMATION ON PROSPECTIVE ACREAGE FIGURES

Company—	First year: Year ended	Quantity	Source	Year 1945: Quantity	Source
Amerada	1941	*850,000	A.R. (1,042,000 gross)	1,165,000	A.R.&M.
Argo	1937	132,000	S.S. incl. 37,000 royalty	240,000	M.
Atlantic	1941	*1,350,000	A.R. (1,400,000 gross)	*4,469,000	A.R. (4,549,000)
Barnsdall	1941	676,000	A.R.	688,000	A.R.
Continental	1941	1,246,000	A.R.	1,752,000	A.R.
Gulf	1940	8,000,000	Estimate	10,467,000	S.S.
Honolulu	1939	*220,000	A.R. (241,000 gross)	*332,000	A.R. (368,000)
Houston	1940	†503,000	A.R.	†607,000	A.R.
Humble	1940	8,049,000	M.	16,513,000	M.
Mid-Continent	1941	728,000	A.R.	776,000	A.R.
Ohio	1940	1,385,000	A.R.	‡2,100,000	2,248,000 in 1946
Phillips	1940	1,964,000	A.R.	4,067,000	A.R.
Pure	1941	1,328,000	M.	2,852,000	M.
Richfield	1940	*168,000	M.	413,000	A.R.
Shell	1941	2,148,000	S.S.	3,524,000	A.R.
Sinclair	1940	3,000,000	M.	5,100,000	M.
Skelly	1941	959,000	M.	1,732,000	A.R.
Standard California	1940	*1,152,000	A.R. (1,271,000 gross)	*2,869,000	A.R. (3,069,000)
Standard Indiana	1940	3,041,000	A.R.	8,336,000	A.R.
Sun	1940	4,242,000	A.R.	7,310,000	A.R.
Superior	1938	637,000	Co. report for 1939	3,500,000	Estimate based on 1946 figure
Texas	1940	*7,000,000	A.R. (7,585,000 gross)	*9,400,000	A.R. (10,056,000)
T. P. Coal & Oil	1940	*400,000	A.R. (444,000 gross)	*400,000	A.R. (455,000)
Tide Water	1941	854,000	A.R.	1,990,000	A.R.
Union	1940	‡300,000	A.R.	‡776,000	A.R.

Explanatory notes: A.R.—Annual Company Report. M.—Moody's "Industrials." S.S.—Standard—Poor's "Corporation Records." *Estimate based on company's report of total (developed and undeveloped or "gross") acreage under lease. †Reflecting 50 per cent interest in 805,000 acres owned jointly with another company. ‡Estimate based on acreage reported to be under lease for prior year.

per cent or more of estimated crude-oil reserves in California are grouped separately from the other companies with reserves of more diverse geographical location. The California group show a weighted average discovery rate of 31.6 bbl. per acre compared with 16.8 bbl. for the weighted average of all 25 companies.

Conclusion

The foregoing method, by employing past discovery results and ownership of prospective acreage, seeks to measure the relative future oil discovery expectancy of various companies. The method assumes that the conversion of acreage into oil reserves will be effected not only through the direct operations of the company concerned, but also through the exploratory activities of competing enterprises. This phase of competition in the industry has in the past operated to an important degree in the discovery results achieved by individual companies, and also accounts in large measure for the industry's present large domestic reserves and its acknowledged world leadership in the art of finding oil.

In seeking to anticipate the future in terms of the past and present, the method is not new. Previously it has found some limited use in the industry as certain companies, in the light of past discovery results, have estimated a probable future crude reserve for their prospective acreage.

That the past and present are at best, however, imperfect guides to the future is obvious. Accordingly, no presumption is made herein that actual future discovery results will conform to expectancy except in a general or approximate way.

Acknowledgment

Grateful acknowledgment is given to Harold J. Wasson, New York. Many of the fundamental statistical data in this article was derived through association (September 1946 to January 1948) with him (and used here by his permission) in petroleum consultant work specializing in the evaluation of oil and gas companies for institutional clients.

BOOKS

MARINE DIESEL ENGINE STANDARDS. Published by the Diesel Engine Manufacturers Association, 1 North LaSalle Street, Chicago. 180 pp. $5.

The text of this volume covers the application, performance, operation, and maintenance of marine diesel engines in the types of craft in which they are commonly used. Fuel oil, lubricating oil, and engine parts and accessories are also discussed. The 19 chapters were written and edited to final form by a committee of engineers, drawn from D.E.M.A.'s membership. Fifty-five illustrations, including charts, diagrams, and action pictures of vessels amplify the text treatment. An "Appendix of Useful Information" contains formulas, tables, and conversion data to round out the book of standards.

PERSONNEL DIRECTORY, PRODUCING DIVISION OF CALIFORNIA OIL OPERATORS, 1948. Issued by Conservation Committee of California Oil Producers, Los Angeles.

This directory gives the names, addresses, and telephone numbers of all active producing companies, together with their operating personnel. The primary purpose of this directory is for use of members of the conservation committee and its subcommittees in contacting with various persons in conjunction with the state conservation program. It has also been found useful as a handy desk reference.

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JOURNAL DESCRIPTIONS OF PETROLEUM ENGINEERING SCHOOLS

School—	Issue date and page
University of Texas	September 6, 1947, p. 81
University of Pittsburgh	September 13, 1947, p. 95
Texas A. & M. College	September 27, 1947, p. 91
University of Oklahoma	October 4, 1947, p. 66
Colorado School of Mines	October 18, 1947, p. 127
Louisiana State University	November 8, 1947, p. 74
Pennsylvania State College	November 15, 1947, p. 312
University of Southern Calif.	November 22, 1947, p. 80
University of Tulsa	November 29, 1947, p. 71
Marietta College	December 13, 1947, p. 95
University of California	December 20, 1947, p. 80
Ohio State University	February 5, 1948, p. 74
Missouri School of Mines	February 19, 1948, p. 115
University of Minnesota	February 26, 1948, p. 125
Montana School of Mines	March 4, 1948, p. 67
New Mexico School of Mines	March 11, 1948, p. 101
Texas Technological College	March 18, 1948, p. 116
Texas Coll. Arts & Industries	April 8, 1948, p. 86

Reprints—Copies of the entire series of articles on Petroleum Engineering Schools, including this final installment, will be available shortly in reprint form at 25 cents per copy. Address inquiries to Circulation Department, The Oil and Gas Journal, Box 1260, Tulsa.

by Kenneth B. Barnes
Engineering Editor

THE above, in brief, are the current figures for United States engineering education. What do they mean to the petroleum industry with respect to its pressing requirements for young engineers, needed to fit into and grow up with the business on its unprecedented program of expansion?

This article presents an over-all picture of the United States engineering colleges and universities as they are today. The names of the institutions, locations, the engineering deans or administrators, current engineering enrollments (both undergraduate and graduate), number of degrees conferred last year, and number on engineering faculty (basis of counting varies with institution) are listed. Some analysis is made of the time when the "demand and supply" for new engineers might become in balance.

This material is designed to follow up or complement the series of articles the Journal has been carrying in recent months for the various petroleum engineering schools. Covered in the series on petroleum engineering schools were their curricula, instructional staff, physical plant and laboratory facilities, enrollment, and other factors (see accompanying box for list). The information was obtained by the Journal directly from the institutions involved with the cooperation of the petroleum-engineering faculty administrators.

Considerable interest has been attached by the industry to the Journal's series on petroleum engineering schools. It has provided one source or means of getting acquainted with some of the institutions which turn out the industry's prospective new engineering employes.

Certainly engineering education is an important subject and today of

DATA ON ENGINEERING ENROLLMENT AND DEGREES CONFERRED, ALL UNITED STATES COLLEGES AND UNIVERSITIES

	Undergraduates							Masters		Doctorates	
Engineering courses—Present scholastic year (as of Nov. 1, 1947):	Freshman (1st yr.)	Sophomores (2nd yr.)	Juniors (3rd yr.)	Seniors (4th yr.)	5th Yr., special, and evening	Total students	No. degrees previous year	Total students	No. degrees previous year	Total students	No. degrees previous year
Petroleum	1,175	1,396	1,159	610	30	4,570	423	89	41	6	3
Chemical	5,962	7,043	5,361	4,013	1,279	23,658	2,560	2,376	656	668	55
Civil	6,331	9,776	7,141	4,730	1,631	29,609	2,592	1,701	668	123	15
Electrical	9,771	19,443	12,794	7,233	3,051	52,292	3,658	3,164	555	314	26
General	4,656	3,299	1,258	533	675	10,421	394	.....	....	....	....
Industrial	1,202	2,496	2,505	1,793	465	8,461	962	556	119	20	....
Mechanical	10,052	17,441	13,166	9,807	2,993	53,459	5,842	2,210	512	109	9
Metallurgical	645	1,100	851	713	141	3,450	522	541	137	74	10
Mining	538	806	577	424	41	2,386	229	48	43	7	2
Others*	17,371	10,333	5,385	3,548	9,541	46,176	2,090	2,072	418	256	13
Total	57,703	73,333	50,197	33,404	19,847	234,484	19,272	12,757	3,149	1,577	133
Prewar and postwar comparison:											
Year 1940-41	33,175	24,242	20,120	16,310	14,444	108,291	11,358	4,582	1,318	624	108
Year 1947-48	57,507	71,615	48,227	32,369	20,462	230,180	18,592	12,643	3,090	1,567	127
Per cent increase 1947-48 over 1940-41	74	195	140	98	42	113	63.5	176	134	151	18

*Includes aeronautical, agricultural, architectural, ceramic, engineering physics, Naval architectural and marine and unclassified engineering courses.

vital interest to the oil business. Expanding as the industry is into repeated new records in drilling, production, natural gas-natural gasoline, transportation, and on other fronts, more engineering manpower is needed. More technilogical ability for much of it is required because the expansions of the industry are not mere simple multiplication of operations that were in practice a few years ago. A great many of the things the oil business is doing today are new. They cover advanced methods and practices, improved equipment and design. All of the calls for more and more engineering talent and assistance.

College enrollment in the United States today is at an all-time peak.

(Continued on page 115)

UNITED STATES ENGINEERING COLLEGES—FACULTY, ENROLLMENT AND DEGREES CONFERRED (1947-1948)

School and location—	Engr. faculty No.*	Engineering dean or administrator	Undergraduates: Total students	Undergraduates: No. deg. previous year	Masters: Total students	Masters: No. deg. previous year	Doctorates: Total students	Doctorates: No. deg. previous year
Arkansas Univ., Fayetteville	13	G. P. Stocker	904	38	.....	.....	.....	.....
Calif. Inst. Tech., Pasadena	161	L. A. Du Bridge	1,323	.....	.....	.....	.....	.....
California Univ., Berkeley Calif. Univ. (L. A.), Los Angeles	98	M. P. O'Brien L. M. K. Boelter	2,821 957	399 6	163 70	38	31 11	1 .....
Calif. Univ. (So.), Los Angeles	38	R. E. Vivian	2,019	272	100	17	1	.....
Carnegie Tech., Pittsburgh	123	R. E. Doherty	2,311	309	187	68	48	3
Case Sch. Appl. Science, Cleveland	125	W. E. Wickenden	2,391	149	133	41	7	.....
Cincinnati Univ., Cincinnati	89	C. A. Joerger	4,094	114	9	.....	12	2
Colorado Mines, Golden	18	M. I. Signer	1,083	98	42	14	.....	.....
Colorado Univ., Boulder	100	C. L. Eckel	3,149	303	286	33	.....	.....
Columbia Univ., New York	90	J. K. Finch	1,428	104	376	126	.....	.....
Cornell Univ., Ithaca, N. Y.	139	S. C. Hollister	2,444	371	95	36	20	3
Georgia Tech., Atlanta	300	B. R. Van Leer	4,465	525	120	29	.....	.....
George Washington, Washington	19	L. R. Lapham	1,122	21	.....	.....	.....	.....
Harvard Univ., Cambridge, Mass.	40	G. M. Fair	177	75	313	243	80	9
Illinois Tech., Chicago	136	J. C. Peebles	6,975	366	660	38	46	6
Illinois Univ., Urbana	158	M. L. Enger	5,775	799	433	208	136	6
Iowa State College, Ames	100	L. O. Stewart	3,798	453	138	50	32	3
Iowa Univ., Iowa City	25	F. M. Dawson	630	92	80	50	24	1
Johns Hopkins, Baltimore	†954	W. B. Kovenhoven	1,421	57	178	26	51	5
Kansas State College, Manhattan	63	R. A. Seaton	2,113	200	45	15	.....	.....
Kansas Univ., Lawrence	63	J. O. Jones	2,168	178	52	.....	.....	.....
Kentucky Univ., Lexington	29	D. V. Terrill	1,491	58	17	2	.....	.....
Lafayette College, Easton, Pa.	35	R. C. Hutchison	868	46	.....	.....	.....	.....
Lehigh Univ., Bethlehem, Pa.	123	H. A. Neville	1,818	247	84	31	19	1
Louisiana State Univ., Baton Rouge	36	L. J. Lascalle	2,375	116	98	7	.....	.....
La. Poly. Inst., Ruston	85	C. Cunningham	788	48	.....	.....	.....	.....
Mass. Inst. of Tech., Cambridge	562	T. K. Sherwood	3,445	740	934	384	.....	39
Mich. State College, East Lansing	56	H. B. Dirks	2,249	169	77	11	10	2
Mich. Univ., Ann Arbor	113	I. C. Crawford	3,839	637	531	206	106	9
Minnesota Univ., Minneapolis	223	S. C. Lind	4,782	317	185	67	58	3
Miss. St. Coll., State College	†166	L. L. Patterson	1,118	.....	.....	.....	.....	.....
Missouri Mines, Rolla	100	C. L. Wilson	2,439	158	78	19	8	.....
Missouri Univ., Columbia	26	H. A. Curtis	1,554	117	24	21	2	.....
Montana Mines, Butte	23	F. A. Thompson	324	27	11	5	.....	.....
Montana St. College, Bozeman	218	E. W. Schilling	1,285	69	32	2	.....	.....
Nebraska Univ., Lincoln	46	R. M. Green	1,530	88	25	2	.....	.....
New Mexico Mines, Socorro	19	E. J. Workman	226	11	23	.....	.....	.....
New Mexico Univ., Albuquerque	18	M. E. Farris	868	33	1	2	.....	.....
New York City College, New York	...	A. B. Newman	5,013	273	.....	1	.....	.....
New York Univ., New York	110	T. Saville	2,899	318	632	77	83	.....
Northwestern Univ., Evanston, Ill.	75	O. W. Eshbach	1,024	101	83	41	26	.....
Notre Dame Univ., South Bend, Ind.	74	K. E. Schoenherr	1,069	164	56	21	1	.....
Ohio Univ., Athens	†185	J. C. Baker	838	.....	.....	.....	.....	.....
Ohio State Univ., Columbus	90	C. E. MacQuigg	4,247	275	.....	.....	.....	.....
Okla. A. & M. College, Stillwater	48	E. R. Stapley	2,505	128	65	27	.....	.....
Oklahoma Univ., Norman	64	W. H. Carson	3,387	288	47	6	.....	.....
Pennsylvania Univ., Philadelphia	73	G. W. McClelland	823	41	392	25	43	3
Penn. State Coll., State College	102	H. P. Hammond	3,790	263	160	53	62	6
Pittsburgh Univ., Pittsburgh	75	E. A. Holbrook	3,081	275	437	43	49	5
Princeton Univ., Princeton, N. J.	40	K. H. Condit	618	124	73	28	19	.....
Purdue Univ., West Lafayette, Ind.	127	A. A. Potter	8,018	879	287	114	47	2
Rensselaer Poly. Inst., Troy, N. Y.	289	L. W. Houston	3,831	501	237	68	15	.....
Rice Institute, Houston	†70	W. V. Houston	599	118	10	5	.....	.....
So. Methodist Univ., Dallas	32	E. H. Flath	829	45	.....	.....	.....	.....
Stanford Univ., Palo Alto, Calif.	49	F. E. Terman	895	.....	244	163	64	3
Syracuse Univ., Syracuse	40	L. Mitchell	1,718	66	90	7	2	.....
Texas A. & I. Coll., Kingsville	...	F. H. Dotterweich	428	9	.....	.....	.....	.....
Texas A. & M. Coll., College Station	162	H. W. Barlow	4,201	587	111	23	.....	1
Texas Tech. Coll., Lubbock	102	O. V. Adams	1,685	120	2	.....	.....	.....
Texas Univ., Austin	†303	W. R. Woolrich	3,710	404	178	50	27	2
Tulane Univ., New Orleans	48	J. M. Robett	638	89	18	.....	.....	.....
Tulsa Univ., Tulsa	33	R. L. Langenheim	639	21	19	11	.....	.....
Virginia Poly. Inst., Blacksburg	...	E. B. Norris	3,205	361	91	37	5	.....
Washington Univ., St. Louis	117	A. S. Langsdorf	1,238	94	59	14	9	.....
West Virginia Univ., Morgantown	36	R. P. Davis	1,367	76	20	4	4	1
Wisconsin Univ., Madison	...	M. O. Withey	2,968	255	124	44	4	7
Wyoming Univ., Laramie	9	R. D. Goodrich	749	55	15	4	.....	.....
Yale Univ., New Haven	57	S. W. Dudley	1,422	316	66	62	40	5
Others‡	...		74,747	4,536	3,527	371	365	.....
Total United States schools			226,748	18,592	12,643	3,090	1,567	128

*See discussion. †Total faculty. ‡Akron, Ala. Poly., Ala. Univ., Alaska, Alfred, Ariz., Bradley, Brooklyn, Brown, Bucknell, Buffalo, Catholic, Citadel, Clarkson, Clemson, Colo. A. & M., Conn., Cooper, Dayton, Delaware, Denver, Detroit, Drexel, Duke, Fenn, Fla., Hawaii, Howard, Idaho, Louisville, Maine, Manhattan, Marquette, Maryland, Mich., M. & T., Miss., Nev., Newark, N. Hamp., N. Mex. St. Coll., N. Car. St. Coll., No. Dak. A. & M., No. Dak., Northeastern, Norwich, No. Ohio, Ore., Puerto Rico, Pratt, R. I. St. Coll., Rochester, Rose, Rutgers, Santa Clara, So. Car., So. Dak. Mines, So. Dak. St. Coll., S. W. La., Stevens, Swarthmore, Tenn., Thayer, Toledo, Tufts, U. S. Coast Guard, Union, Utah Agri. Coll., Utah, Vanderbilt, Vermont, Villanova, Va. Mil., Va., Wash. St. Coll., Wash. Univ., Wayne, Webb Inst., Worchester.

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Each Lukens Clad Steel—Nickel-Clad, Stainless-Clad, Inconel-Clad or Monel-Clad —is a precision product controlled from assembly to finish, consisting of a layer of the corrosion-resistant metal permanently bonded to a backing plate of ASME specification steel. The cladding may be any percentage of the total plate thickness from 5% to 50%.

Lukens Clad Steels represent the most complete range available to industry. For additional information, write for Bulletins 338 and 255, Lukens Steel Company, 455 Lukens Bldg., Coatesville, Pennsylvania.

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SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

PROGRESS IN METALS

by W. L. Nelson

Consulting Engineer

Hardness of Microconstituents of Hard-Surfacing Weld Deposits

HARDNESS is a property of metals and alloys that is defined with difficulty because of the many types of service that are encountered. Among these services are ones involving indentation, abrasion, wear, scratching, cutting, machinability, etc. With respect to the conditions under which hard-surfacing weld deposits perform, the Vickers pyramid numbers (V.P.N.), Knoop "I" numbers, and microcharacter are particularly significant. Table 1 compares these hardness measures with the more common Brinell numbers, the Mohr scale of scratch hardness, and the equivalent microconstituents in steels. It was taken primarily from "Hard Surfacing by Fusion Welding," by H. S. Avery (published by American Brake Shoe Co., New York).

The Knoop indenter is a diamond pyramid which differs from the Vickers type in proportions and depth of impression. The indentation is measured microscopically. The Bierbaum "Microcharacter" is a precision scratch-hardness tester. A diamond point, cut as the corner of a cube, is drawn across the specimen under a load of 3 or 9 g. The width of a scratch is measured microscopically and converted to microcharacter numbers and the test appears to be closely related to wear tests. The Vickers diamond pyramid method is similar to the Brinell round-ball test but at very light loads the indentation occurs without fracturing brittle materials. The Tukon tester may be used for Knoop numbers and with modifications, for Vickers pyramid numbers.

All of these tests produce such a small impression that a microscope is used for the measurements. Table 2 shows the hardness of common microconstituents. It also was taken from the booklet by H. S. Avery.

TABLE 1—COMPARISON OF HARDNESS (FOR HARD-SURFACING DEPOSITS)

Mohr No.	Mineral equivalent	Knoop No. (25 g. load)	V.P.N.	B.H.N.	Micro-character	Steel equivalents
1-1.5	Talc	....	....	....	1-21	.....
2-2.5	Gypsum	32	30	30	10-57	.....
3-3.5	Calcite	135	135	135	126-135	Ferrite
4	Fluorite	163	160	160	138-145	Spheroidite
4.5	.....	....	....	....	.....	Coarse pearlite, austenite
5	Apatite	430	430	410	870-1,740	Fine pearlite, coarse bainite
5.5	.....	....	....	....	.....	Fine bainite
6	Orthoclase	560	560	510	2,100-2,500	.....
6.5	.....	....	....	....	.....	Martensite
7	Quartz	790	790	640	2,070-3,900	.....
7.5	.....	....	....	....	.....	Iron carbides
8-8.5	Topaz	1,250	<1,250	....	2,800-4,400	Complex alloy carbides
9-9.5	Corundum	3,000	<3,000	....	3,900-8,300	.....
10	Diamond	8,000	<8,000	....	.....	.....

TABLE 2—HARDNESS OF SOME MICROCONSTITUENTS IN HARD-SURFACING WELD DEPOSITS

	Microhardness		
Constituent—	V.P.N. (25 g. load)	Knoop "I" (25 g. load)	Micro-character "K" (9 g. load)
Ferrite (in 0.20 per cent C steel)	104	154	.....
Pearlite (in 1.6 per cent Cr white cast iron)	250-355	.....	.....
Pearlite (in 1.6 per cent Ni; 1.5 per cent Cr white cast iron)	314	453	.....
Pearlite (in 2.1 per cent Ni; 2.4 per cent Cr white cast iron)	.....	.....	1,100-1,525
Pearlite (in Ni-Cr white cast iron)	.....	.....	772-865
Pearlite (in 7.6 per cent Cr white cast iron)	.....	.....	550
Austenite (3.9 per cent Mn; 3.6 per cent Ni; 2.1 per cent Cr white cast iron)	.....	.....	370-590
Austenite (1.5 per cent C; 11.8 per cent Cr steel)	353	412	.....
Austenite (in Ni-Resist cast iron)	165-243	.....	.....
Martensite (in Ni-Hard cast iron)	390-640	506±	1,200-2,500
Martensite (in Cr-Mo cast iron)	473	682	.....
Cementite (iron carbide in gray cast iron)	940	.....	.....
Cementite (in 1.6 per cent Cr white cast iron)	855-1,080	.....	.....
Cementite (in Ni-Hard cast iron)	1,052-1,600	1,106+	2,660-9,000
Cementite (in pearlitic white cast iron)	1,128-1,270	1,720	.....
Chromium carbides (24 per cent Cr white cast iron)	.....	.....	5,350-7,400
Chromium carbides (1.5 per cent C; 11.8 Cr. steel)	1,960	.....	.....
Chromium carbides (Cr-Co-W)	1,672-2,520	1,720-2,220	5,730-7,570
Chromium boride (Ni-Cr-B-C)	2,668	2,912	.....

Low-Temperature Properties Of 8½ Per Cent Nickel Steel

INCREASING use of low-temperature processing, and the advantages associated with storage of gases in liquefied form, have stimulated interest in finding a moderately priced material of construction that is resistant to the embrittling effects of low temperature and which can be fabricated under somewhat the same conditions employed for structural steel.

Any material considered must not only be readily weldable by accepted commercial methods but must also meet the mechanical-property requirements after welding. If the requirements can be met in the as-welded condition, the material has an added advantage, although a simple stress-relief anneal or comparable thermal treatment is not prohibitive.

In searching for a ferritic steel that would meet the conditions it was decided to extend existing knowledge of the effect of nickel on low-temper notch toughness of steel by increasing the nickel content to 5 per cent and testing at temperatures below —200° F. Test results led to stimulation of interest in the effect of larger nickel additions and to study of low-carbon steels containing nickel in excess of 5 per cent.

Melts were made in which nickel was increased progressively from 6 to 13 per cent, and tested at room temperature and at temperatures down to that of liquid nitrogen, —320° F. There was a rapid improvement in impact resistance at —320° when the nickel content approached 8 per cent. Further study was limited to compositions containing nominally 8½ per cent nickel, as this level was considered the most economical on the basis of alloy cost, and was sufficiently high to compensate for variables in composition and processing.

Development of low carbon 8½ per cent nickel steel was primarily for low-temperature service, but it is surprising to find that the product is being considered for many fields of use in which low temperatures are not a factor. It should not be considered as a substitute for the austenitic chromium-nickel stainless steels, although it may be suitable for application involving a particular type of corrosion; neither is it suggested as a replacement for the low-alloy steels for applications in which high strength is the primary consideration. In certain respects this new nickel steel does have an attractive combination of properties which, together with its moderate price, will ultimately determine its proper position as an engineering material.

Abstracted from "Some Properties of Low Carbon 8½ Per Cent Nickel Steel," by Armstrong and Brophy, National Conference on Petroleum Mechanical Engineering of the American Society of Mechanical Engineers, Houston, October 5-18, 1947.

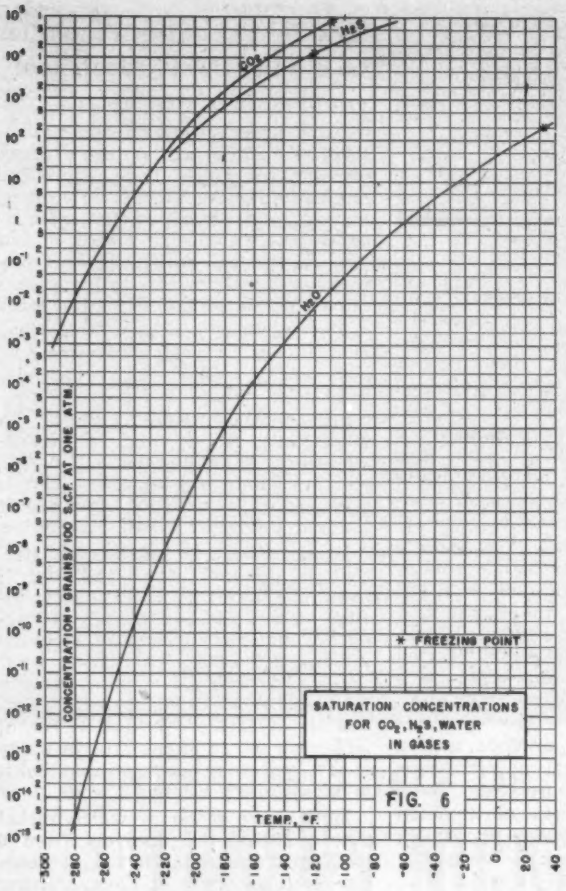

FIG. 6

turn to materials other than the low-nickel steels; 18-8 stainless steel, copper, brass, and bronzes are all common materials used in the temperature range —100° to —300° F. Aluminum and its alloys show promise of widespread economical application at low temperatures. For special applications where their great strength may compensate for their high cost, nickel and high-nickel alloys have excellent low-temperature characteristics. The choice of metals to be used becomes a matter of balancing the structural strength of the materials against their cost per pound to give the most economical design. Where low pressures and small-diameter vessels are used, copper is generally the choice. If pressures are high, the use of higher-strength materials such as stainless steel or bronzes is dictated.

Nitrogen Removal From Natural Gas

(Continued from page 98)

the impact strengths of all metals generally decrease with decreasing temperature. The impact strength of some metals, such as most carbon steels, falls off so rapidly that they are entirely unsuitable for low-temperature application, while that of other metals, such as austenitic stainless steels (18-8), decrease very little, if at all, down to temperatures of —300° F.

It has been shown[12] that carbon steels which have been properly deoxidized during the melting process and contain a minimum of carbon may be used at a temperature of —60° F. Such steel showed charpy impact strengths above 10 at —100° F. but the charpy impact strength of the weld metal decreased rapidly with lowered temperature from a value of over 14 at —60° F.

Low-nickel (2¼ and 3½ per cent) steels when properly deoxidized are quite satisfactory for use at temperatures down to —100° F. This material, however, is about twice as expensive as carbon steel.[13]

When temperatures below —100° F. are encountered it is necessary to

Acknowledgment

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Preplanning and Prefabrication

(Continued from page 86)

$21,000, and the actual construction time of 28 to 42 days. Part of the difference in cost and time could be charged to the contractor and his men not being familiar with the job and the equipment, but it is believed a share should be charged to the preliminary study and plans made to coordinate and schedule all work so as to accomplish the maximum in the least time. For example, at the start of the job, three boilermaker gangs went to work on the furnace, one gang each on the right and left walls of the furnace unplugging tubes and the third erecting scaffolding on the front and rear walls for removing the roof and roof insulation. As soon as the gangs had the tubes unplugged, acetylene burners stepped in and started cutting off header boxes. Meanwhile, upon erection of the scaffolding, other burners started cutting off the roof studs while yard labor and the crane moved the transite off into waiting trucks to be hauled away. As soon as the transite roof was off, the burners cut off the roof members so as to allow the yard to remove the roof insulation without obstructions. Most of the time during dismantling, work by the crafts was going forward on the right and left walls, and on top simultaneously.

At all times, labor was assigned to keeping the platforms and area cleared of debris and scrap. For the first 2 days, extra men were assigned to help move off the headers, plugs, and brick. The old headers and plugs were inspected, the bad ones scrapped, while the remaining headers were stored as spares for the vapor-

phase convection banks and the liquid-phase furnace.

Work was scheduled around the clock and permitted the scheduling of interfering jobs at times when the crafts composed of small forces could be staggered. For example, the instrument department, composed of three men, installed thermocouple wiring in the daytime on May 3, 4, and 5, while the roof insulation covering the roof arch block was laid at night.

23,000 Engineers

(Continued from page 109)

Of the country's 140 million plus population, our colleges today have 2,333,000 students enrolled. In simple ratio, this is 1 college student for each 60 persons. Engineering courses are in good demand, too, as one out of every nine college students is taking engineering (see table below).

	1940-41	1947-48
Total college enrollment in the United States	1,490,000	2,333,000
Total engineering enrollment in the United States	113,497	244,390
Per cent engineering to total	7.6	10.5

The petroleum-engineering schools cannot hope—nor are they designed or intended—to fulfill all of the requirements for engineers needed for the petroleum industry. As a matter of fact, petroleum engineering is one of the youngest of the many branches of engineering education and, all told in the petroleum industry, there are more engineers originating from the chemical, civil, electrical, general, industrial, mechanical, metallurgical, and mining branches. The accompanying table shows the current enrollment in each of these engineering divisions.

More Engineers—How Soon?

While new engineers from educational institutions have been in short supply for several years and the demand continues to exceed substantially the available graduates, studies made by the American Society for Engineering Education and the Bureau of Labor Statistics of the U. S. Labor Department indicate that satisfactory numbers of trained engineers should be met by 1950 or shortly thereafter. In 1940, the census showed 45 million employed persons in the United States for that year, and of whom some 246,000 were engineers (additionally there were 16,000 engineers unemployed in 1940).

The B. L. S. estimates, under conditions of "full employment," the total United States employment at 57½ million persons (this figure later has been raised somewhat). The corresponding figure for engineers, if increased in the same proportion to a condition of full employment, would necessitate about 315,000 engineers (all industries). However, since increases among engineers would not be uniform in all activities, the A.S.E.E. has made certain pertinent adjustments to arrive at the number of engineers required under full employment, and found the total to be at least 337,000.

On the assumption that the needed engineers are to be obtained by 1950, since there were 261,000 engineers in 1940, the remainder of 76,000 would have had to be added in 1940-1950, plus the additional number needed to offset those lost by death, retirement, and leaving the profession.

B. L. S., from life-expectancy and age-distribution tables for the engineering profession, has estimated the attrition due to death as 1¼ per cent per year. For retirement and leaving the profession, the National Roster of Scientific and Specialized Personnel has estimated (from its wartime registrations of engineers) that these factors constitute a loss of 1¾ per cent per year. Thus the total losses amount to about 3 per cent per year, or a total of 30 per cent for 1940-1950.

From "Demands for and Supply of Engineering Graduates"* the need for engineers is summarized in the following form:

Total number needed in 1950	337,000
Number available in 1940 (including 16,000 unemployed)	261,000
Shortage	76,000
Attrition (30 per cent of 261,000)	78,000
Addition needed 1940 to 1950	154,000
Degrees granted 1941 to 1946	64,000
Needed 1946 to 1950	90,000

For the estimated 90,000 engineers needed in all United States industries in 1946-1950, this amounts to approximately 23,000 engineers to come from the engineering schools each year during that interval.

It is of interest to note that for the past school year there were 22,554 undergraduate and graduate engineering degrees conferred (see table). This number of degrees granted last year corresponds very closely to the requirements of 23,000 per year as estimated above, that are necessary to provide a solution by 1950 to the past and current scarcity of engineering graduates.

While these figures are on an all-industry basis, the number of engineering students that move into the oil business is favorable. All indications are that the estimates given here will apply equally well, and probably better, to the petroleum industry specifically.

*Journal of Engineering Education, Vol. 37, No. 1.

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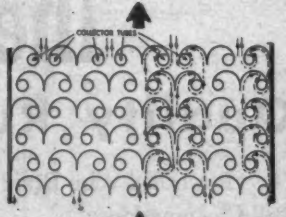

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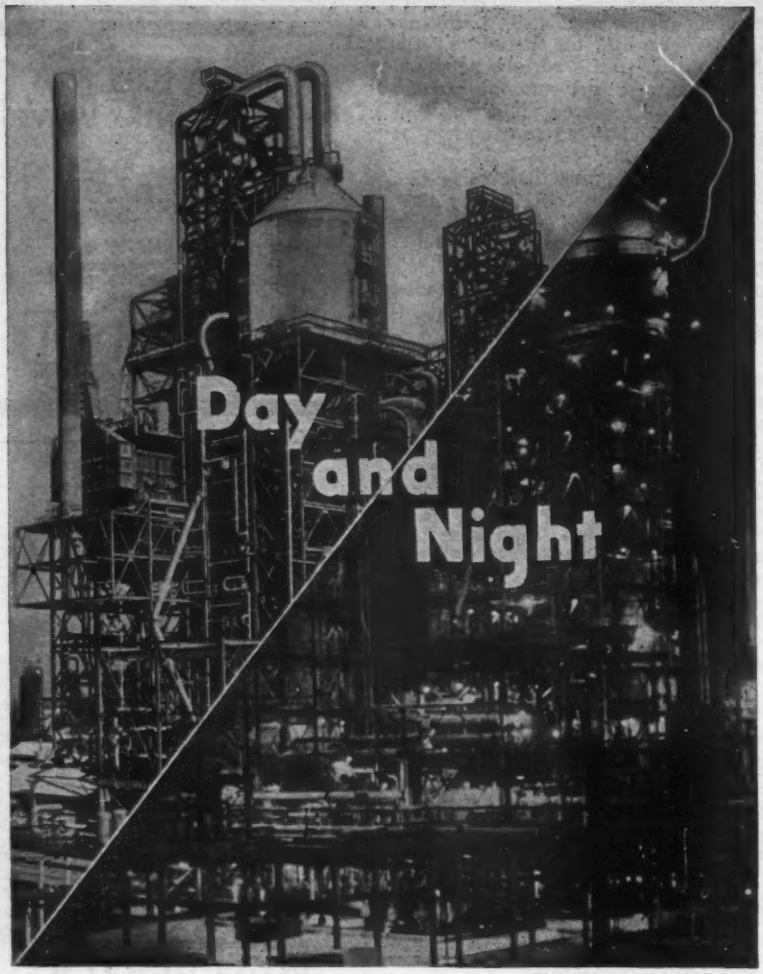

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Maintaining Indicating, Recording Instruments

(Continued from page 91)

the thermocouple and connect a portable potentiometer to the thermocouple terminals. Apply e.m.f.'s to simulate several temperatures within the proper range of the instrument. If the instrument does not read correctly, the trouble is in the measuring circuit. If the instrument does read correctly, then the difficulty is in the thermocouple or thermocouple extension wires. This test can be made by short-circuiting the thermocouple terminals instead of connecting a portable potentiometer to these terminals. In this latter case, the instrument should indicate ambient temperature.

Checking where balancing motor drives in one direction.—Connect a portable potentiometer to the thermocouple terminals of the instrument and apply large potentials of both polarities. If the motor will drive in both directions, the difficulty is probably due to reverse connections which cause the motor to drive away from the balance point. The reverse connections may be the amplifier input leads, or the leads to the motor.

Checking for loss of sensitivity or speed.—These factors again are a function of motor performance or the means supplied by the manufacturer for sensitivity adjustment. Motor checking has just been described and should the motor not be proved to be the cause of lost speed or sensitivity, the sensitivity adjustment should be checked according to manufacturer's instructions.

Checking for calibration shifts.—Certain difficulties may cause shifts in calibration. These usually can be corrected by the calibration adjustments on the slide wire, but before these adjustments are made any factor which may cause a calibration shift should be eliminated.

Make certain that the checking equipment and procedures are sufficiently accurate before considering the instrument in error. Narrow spans, in particular, require more accurate checking equipment than is generally available in the field. As previously stated, laboratory-type precision potentiometers are preferred as standards for checking calibration.

Check the accuracy of calibration of the instrument by applying potentials to the instrument which correspond to several temperatures for the type of thermocouple concerned. These potentials can be ascertained from tables of e.m.f. vs. temperature for the type of thermocouple involved. If the instrument reads correctly for each step in this checking procedure, the instrument is in calibration and any inaccuracy present is due to the thermocouple or thermocouple extension wires.

ENGINEERING Fundamentals

Capillary Pressure—Unconsolidated Sand

THE concept of capillary pressure as the pressure drop between fluid phases in a capillary system, and the expression for capillary pressure in a single straight capillary was presented in Engineering Fundamentals No. 327. The straight-bore capillary, is, however, an ideal and simple system, and although useful for explaining basic concepts, it does not give the quantitative expression sought for the capillary behavior in porous materials. Reservoir materials also are varying in complexity of pore structure, and a simple or ideal porous structure is required as a starting point to explain their capillary behavior. The ideal pore configuration usually chosen is that made up of spherically uniform particles of definite size, i.e., an unconsolidated sand. The capillary pressure for this system has been presented in the literature* and will be reviewed here.

Consider two spherical grains in contact as shown in Fig. 1 with a wetting fluid at the point of contact. A contact angle of zero will be assumed in order to have the condition of a continuous film of the wetting phase around the sand grain. In this system the capillary pressure is given by

$$P_c = 2\gamma\,(1/R_1 + 1/R_2) \qquad (1)$$

where R_1 and R_2 are the radii defining the curved fluid interface as shown.

Now the values of R_1 and R_2 express the amount of fluid that is contained at the contact, or the saturation of that fluid within the porous body if a number of such contacts are considered. Therefore, Equation 1 states that the capillary pressure is dependent upon the saturation of the fluid phase which wets the system, although the exact nature of the dependence may not be simply stated because the variation of the saturation with R_1 and R_2 may not be simply stated.

Capillary pressure is that pressure across the phase boundary. If water is considered to be the wetting fluid and oil the nonwetting fluid, then the capillary pressure across any interface is

$$P_c = P_o - P_w \qquad (2)$$

Now consider two such contacts as are shown in Fig. 1, at two different heights in a porous section, one at h_A, the other at h_B. The capillary pressures at the two heights are

$$P_{cA} = P_{oA} - P_{wA}, \text{ and}$$
$$P_{cB} = P_{oB} - P_{wB} \qquad (3)$$

where subscripts A and B refer to heights A and B, and subscripts o and w refer to oil and water phases. If it is assumed that the oil and water phases are both continuous between A and B the pressure differences can be expressed by the densities of the oil and water, ρ_w and ρ_o, or

$$P_{oA} = P_{oB} - \rho_o g\,(h_A - h_B)$$
$$P_{wA} = P_{wB} - \rho_w g\,(h_A - h_B) \qquad (4)$$

Combining Equations 3 and 4 gives

$$P_{cA} - P_{cB} = (\rho_w - \rho_o)\,g\,(h_A - h_B) \qquad (5)$$

which states that the capillary pressure is greater at A than at B, or that capillary pressure increases with height in a reservoir.

From Equation 1 it is noted that capillary pressure increases as the radii, R_1 and R_2, decrease. The latter occurs when a smaller amount of water exists at the grain contact. In other words, a smaller water saturation gives a greater capillary pressure. Thus, Equation 5 demands that the water saturation must decrease with height in a reservoir. The exact rate of change of water saturation with height is not readily apparent because the variation of saturation with R_1 and R_2 is not readily apparent.

Although it is not so apparent, Equations 1 and 5 together also demand the result that at a given height within a reservoir, the amount of water that is held by capillary forces will increase as the permeability decreases.

The experimental determination of water or oil saturation held by capillarity as a function of height in a sand column has been performed by a number of investigators, and the results have shown a characteristic type of curve. Fig. 2 shows the curves for oil, water, and normal heptane saturation versus height in an unconsolidated sand column where the fluids were retained due to capillary forces. As shown by Equation 5, these curves could just as well represent capillary pressure instead of height if h_B be taken as zero where P_{cB} is zero, which point will be that of 100 per cent fluid saturation at the bottom of the column. In this particular instance, the amount of fluid that is contained at a given height will vary since Equation 1 includes the factor γ. Furthermore, since these investigators had to repack their column to obtain each curve, the pore structure was probably not exactly duplicated.

*Leverett, Capillary Behavior in Porous Solids, A.I.M.E. Trans. 1941.

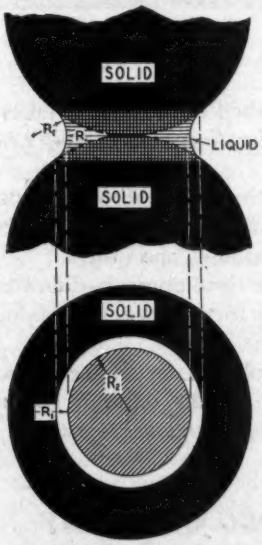


Fig. 1—(Leverett, A.I.M.E. Trans., 1941, Vol. 142, p. 153)

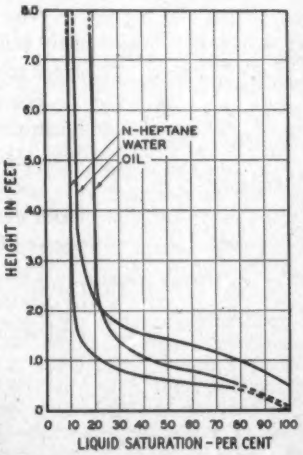
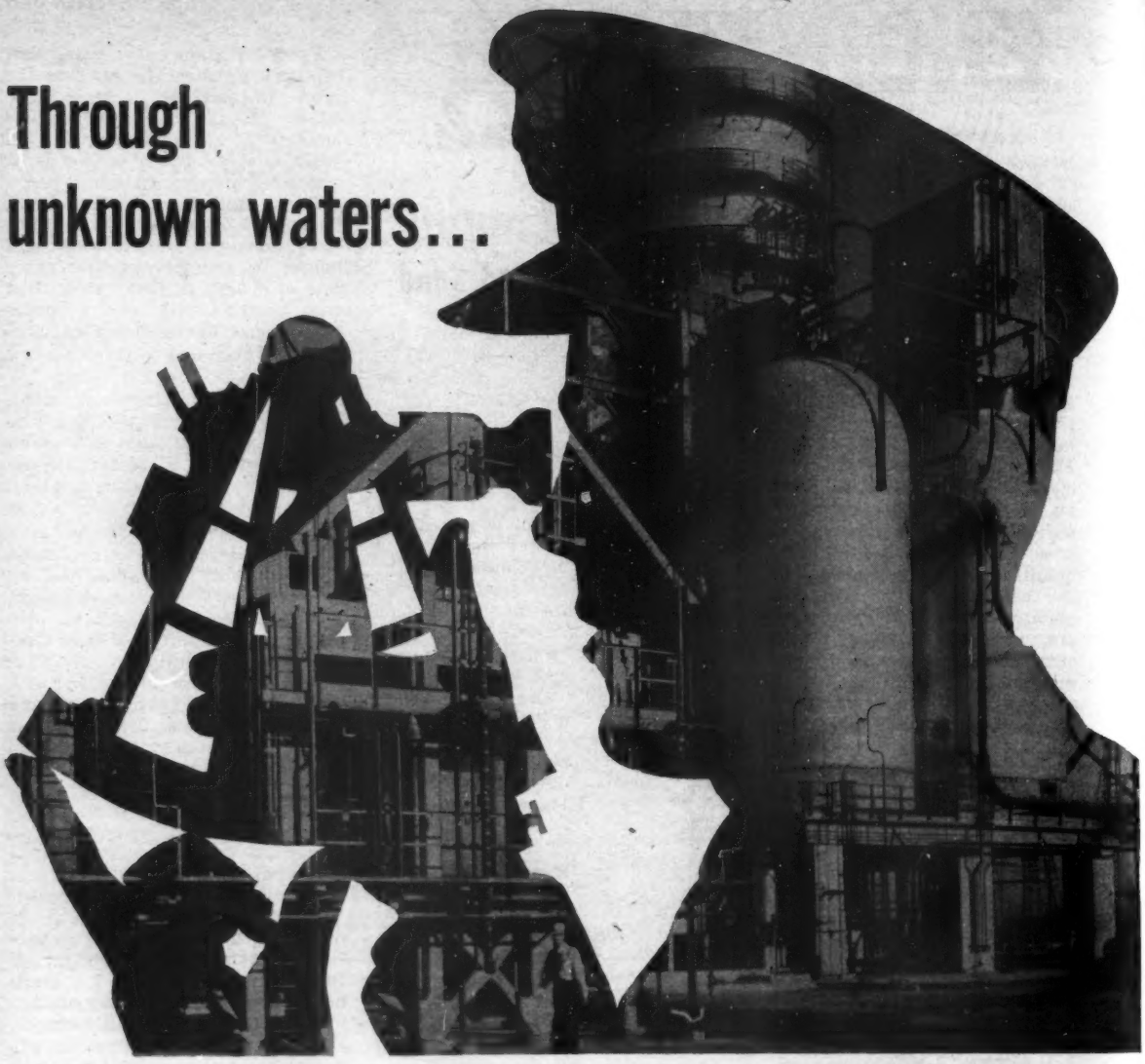


Fig. 2—(Stahl, Martin, and Huntington, A.I.M.E. Trans., 1943, p. 140)

Series prepared by Dr. John C. Calhoun, Jr., Petroleum Engineering School, University of Oklahoma

Through unknown waters...



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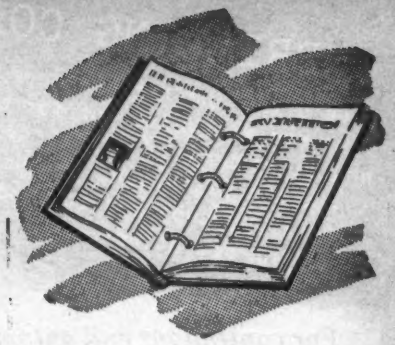

Sampling Methods for Liquids

ONE would think that sampling is such a routine and simple matter that little attention is required, but the erroneous conclusions that can be drawn from a nonrepresentative sample are so confusing and sometimes so expensive that all of the skill of a conscientious and able man is required.

Weighted bottle or beaker.—Although various metal containers called oil thieves are recommended for the sampling of cans, barrels or tank cars, the most widely used sample container is the weighted bottle. It consists of a bottle with a weight and string or chain attachment fastened to the bottle and cork, as indicated in Fig. 1, so that a quick jerk on the line will uncork the bottle. A more elaborate bottle arrangement is recommended by the A.S.T.M. (D270, Methods of Sampling Petroleum Products, A.S.T.M., 1916 Race Street, Philadelphia), and metal containers or beakers are also employed (A.S.T.M. D270; also A.P.I. Code No. 25, American Petroleum Institute, 50 West 50th Street, New York; also Instructions for Measuring, Sampling, and Testing Petroleum Shipments, Standard Inspection Laboratory, Standard Oil Development Co.). The bottle neck opening is 1½ in. in diameter for heavy crude oils or fuel oils, and for heavy lubricating oils. For other materials a ¾-in.-diameter neck is adequate.

Samples are taken by lowering the lightly corked bottle to a suitable level and uncorking it by a quick jerk. After bubbles cease the full bottle is immediately withdrawn. It is preferable to send the sample to the laboratory in the bottle in which it was collected.

True or average samples are scarcely possible although the continuous collection of a sample from a pipe line or the mixing of the contents of a container may nearly attain such perfection. Accordingly, **spot samples** taken at various levels or areas of the container must usually suffice.

All-level samples are obtained by lowering the weighted bottle to the level of the drawoff, dislodging the cork, and raising the sample at such a rate that it is nearly but not full as it emerges. Such a sample is usually primarily for routine control.

Upper samples are taken at a point 10 per cent of the depth of the oil, or for full horizontal cylindrical tanks at 10 per cent of the diameter of the tank.

Middle samples are taken at half the depth of liquid.

Bottom samples are taken at 10 per cent of the depth or 10 per cent of the diameter of horizontal tanks, from the bottom.

These samples are mixed as follows for a **composite sample:**

	Uniform cross-section vessels	Full horizontal cyl. tanks
Upper sample	1 part	1 part
Middle sample	3 parts	8 parts
Bottom sample ...	1 part	1 part

The proportions of composite samples in terms of upper, middle, and bottom samples for partly filled horizontal tanks are suggested in A.S.T.M.—D270.

Fig. 1—Weighted bottle for sampling

Tanks, tank cars, trucks, shore tanks, ship tanks, and barge tanks are usually sampled by preparing a composite sample from upper, middle, and bottom samples in suitable proportions. For containers of unusual shapes, the proportions for compositing can be agreed upon.

It is also common practice to sample tanks through the drain line or sample cocks near the bottom of the tank because of the simplicity of such a method. Such a method cannot be used for controversial samples and hence agreement about such a method must be made in advance.

Continuous samples.—In sampling pipe-line or certain process liquids, the continuous method is widely used and if open discharge points are available, the **dipper method** may be used. The dipper method consists simply of obtaining samples of the full stream of liquid at uniform intervals of time, and mixing all of the dippers into a composite sample.

Continuous sampling requires the use of sample cocks with lines leading into the pipe line or vessel. The A.S.T.M. recommends a three-cock arrangement the three lines of which lead to points 0.05, 0.15, and 0.30 diameters into the pipe. The three cocks are adjusted so that the same amount of liquid issues from each of them and they are opened to such an extent that one-tenth of the liquid flowing is diverted, or a total of 40 gal. is accumulated during the flow.

Note.—The temperatures at which samples must be taken or handled in order to avoid vaporization losses that will alter the sample will be discussed in The Refiner's Notebook No. 197, May 20.

Correction

In The Refiner's Notebook, installments 183 and 185, (February 12, 1948, page 109 and February 26, 1948, page 147) pertaining to the viscosity of oil vapors and gases, micropoises are defined as one-thousandth of a poise. Actually, a micropoise is one-millionth of a poise.

No. 193 in a series by W. L. Nelson, professor of petroleum refinery engineering, University of Tulsa

DRILLING CONTRACTORS:

Here's the Shaffer Pressure Control Hook-Up that meets your every requirement for maximum safety, simplicity and wide-range adaptability. Check its many advantages . . . its all-around protection and versatility. You'll find it unsurpassed for modern drilling operations.

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THE SHAFFER COMBINATION ROTATING BLOW-OUT PREVENTER AND STRIPPER

No matter how sudden the pressure emergency, it can't happen too fast for this pressure control unit *because it is always packed off around the drill string as long as pipe is in the hole!*

No levers or valves to operate. No time delay. It maintains its pressure-tight seal *continuously*, even around varying diameters and shapes. These are a few of its many unique features . . .

ANY SHAPE! The Stripper Rubber automatically expands and contracts to maintain a tight seal around any diameter in the drill string (except for such abnormally large diameters as reamer and bit). It seals off around the kelly, whether square, hexagonal or octagonal . . . and around the varying diameters of drill pipe, couplings, tool joints and drill collar. Adjustment to different diameters and shapes is completely automatic — no manual operations are necessary.

CONTINUOUS SEAL! Not only does the Stripper Rubber seal off around any shape or diameter in the drill string, but its automatic and instant adjustment to varying shapes and sizes permits the drill string to be stripped in and out of the unit without losing seal at any time. Pipe is run into the hole and removed with the same convenience and simplicity as in conventional drilling operations.

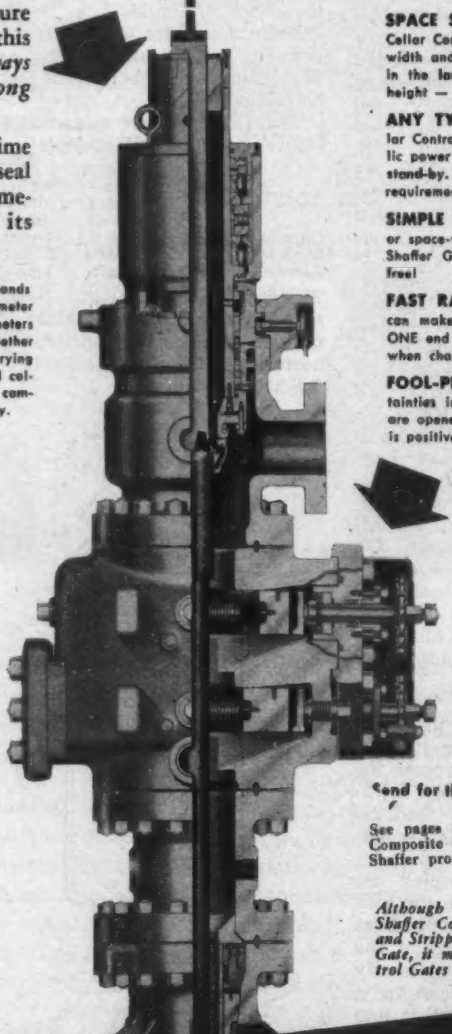
MINIMUM WEAR! Since the Stripper Rubber rotates with the kelly — not around it — there is practically no wear on the rubber. Maintenance is negligible.

QUICK RELEASE! When running such large tools as the bit or reamer through the unit, simply pull a spring latch, rotate the bonnet 1/6th turn and the complete rotating assembly is readily withdrawn from the body on top of the bit or reamer. When going back into the hole simply reverse the operation. It's quick and simple!

UNUSUALLY COMPACT! The Shaffer Combination Rotating Blow-Out Preventer and Stripper is so engineered that vertical height in the drilling riser is kept at a minimum. In addition, flow connections built directly into the body eliminate need for spools or other accessories for overflow connections, thus saving still more space.

STEEL PROTECTED RUBBER! Note how the Stripper Rubber is backed by flexible steel latches (A) which form an expandable steel barrier to prevent extrusion when the rubber is subjected to unusually high pressure or to abnormal expansion. This flexible steel barrier so protects the rubber that large diameters can be pulled through it without damage . . . and even extremely high well pressures will not cause the rubber to extrude.

There are many other features that make this unit outstanding for highest efficiency and safety in modern drilling operations. Write for the complete details.



For complete shut-off whether drill string is in or out of well . . .

THE SHAFFER DOUBLE CELLAR CONTROL GATE

This unit not only provides complete shut-off of open hole, but also seals around the drill string to provide added protection and safety when blow-outs threaten while pipe is in the hole. Note its compactness and fool-proof dependability — how it can be easily adapted to varying power requirements — and other outstanding advantages . . .

SPACE SAVING COMPACTNESS! All Shaffer Cellar Control Gates are unusually compact in length, width and height. And the Shaffer Double Gate, even in the largest size, requires less than 29" of cellar height — smaller sizes even less!

ANY TYPE POWER! You can operate Shaffer Cellar Control Gates with air, steam, electric or hydraulic power drives — plus the added safety of manual stand-by. There's a choice of power to meet every well requirement!

SIMPLE INSTALLATION! No complicated piping or space-wasting pressure manifolding is required for Shaffer Gates. Installation is simple, clean, clutter-free!

FAST RAM CHANGES! With Shaffer Gates you can make a complete ram change by removing just ONE end cover. Saves time and simplifies operations when changing from one pipe size to another!

FOOL-PROOF OPERATION! There are no uncertainties in operating Shaffer Gates because the rams are opened and closed by direct mechanical drive. It is positive and trouble-free!

NON-CREEPING RAMS! Only one quick operation is required to close the Shaffer Gate — and keep it closed. No auxiliary locking devices or extra operations are necessary because Shaffer rams automatically stay in whatever position they are set. This means extra safety in emergencies!

Shaffer, pioneer of modern pressure control equipment, also offers a complete range of control equipment in addition to the units shown above . . . Shaffer Kelly Cocks, Shaffer Adjustable Flow Beans, Shaffer Landing Heads, Tubing Heads, and other control equipment . . . plus a complete line of field-proven fishing tools.

Send for the complete Shaffer Catalog!

See pages 3843 to 3894 of your 1948 Composite Catalog for more details on Shaffer products.

Although the above Shaffer Hook-Up shows the Shaffer Combination Rotating Blow-Out Preventer and Stripper with the Shaffer Double Cellar Control Gate, it may also be used with Shaffer Single Control Gates in any arrangement, if desired.

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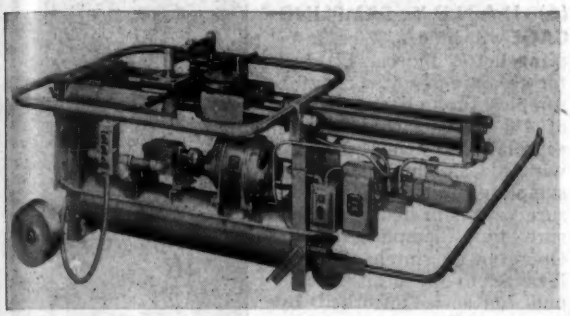
OIL AND GAS EQUIPMENT Digest

IT'S NEW CHECK IT

by John M. Spears

(1) NEW BENDING MACHINE is portable, hydraulic, ram type. Machine requires no repositioning of dies nor relocating of pipe when bending up to 180° in one con-



tinuous operation. Equipped with standard die equipment for bending up to 2-in. extra-heavy-weight steel pipe. Special dies available for angle iron, channels, reinforcing bars, flat bars, etc. Push-button controlled for maximum production output. "Jog" button provided to facilitate setups or accurate duplications of special parts formed to templates. *Wallace Supplies Manufacturing Co.*

IT'S NEW CHECK IT

(2) NEW FLEXIBLE TUBING withstands abuse and deterioration from oil, grease, and grime. Improvements are the result of new Buna and Neoprene-base synthetics which stand up under the terrific punishment of high temperatures, pressures, vibration, internal and external corrosive solvents, and fumes. Assembly illustrated is carrying air at 80 psi. One-quarter-inch tubing will stand burst pressure to 1,000 psi. and larger sizes proportionally less. Installations for temperatures to 300° F. are not uncommon. Rugged, lightweight couplings, provided with standard assemblies, snap on or off in a second to save maintenance time, yet provide a tight positive grip that eliminates all trouble due to leaking joints. No packing is necessary, no tightening required. *Ronaflex Tubing Co., Inc.*

IT'S NEW CHECK IT

(3) NEW ENGINE STARTERS enable quick starting of large flywheel engines. They are furnished as a complete unit and consist of an engine, V-Belt drive, friction pulley, lever, base, and belt guard. Installation is sim-

ple and inexpensive. There are four models for engine sizes 15 through 80 hp. Special units can be designed for engines of over 80 hp. Starters are always ready for immediate use—no waiting for air pressure to build up—no bad air mixtures to cause starting difficulties. No piping, pressure gages, or popoff valves are required. *Happy Co.*

IT'S NEW CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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piping; types of stainless steels; standardization of pipe and fittings; and selection of pipe joints. Contains numerous tables and illustrations. *Tube Turns, Inc.*

IT'S NEW ✓ CHECK IT

(13) DUAL-FUEL ATTACHMENT. A four-page pamphlet underscores the versatility of an engine when dual-fuel attachment is added. Points out the economic operation of the entire unit when utilizing natural gas. Speed of installation and ease of operation emphasized. *Caterpillar Tractor Co.*

IT'S NEW ✓ CHECK IT

(14) WIRE ROPE. A two-color combination catalog and handbook is available to wire-rope users. New 119-page publication contains useful information in selecting, buying, and using wire rope along with data on fittings attachments, splicing, and other related subjects. *Wire Rope Institute.*

IT'S NEW ✓ CHECK IT

(15) IMPROVED BACKSTOP. New four-page bulletin provides complete easy-to-read information on the construction and operating advantages of manufacturer's backstop. Material emphasizes gripping action of backstop that takes place at the precise moment that forward rotation ceases. *Falk Corp.*

IT'S NEW ✓ CHECK IT

(16) ANTICORROSION COATING. New brochure on anticorrosion coating for interiors cites applications to tanks in sour-crude fields. Also described briefly are research programs of major oil companies. *Minnesota Mining & Manufacturing Co.*

IT'S NEW ✓ CHECK IT

(17) ELECTRONIC CONTROL UNIT. A detailed catalog and price sheet cover manufacturer's new Leveltronic Relay designed for basic applications in the control of liquid level, interface, pressure, and temperature. *R-S Products Corp.*

IT'S NEW ✓ CHECK IT

(18) BOILER FEED PUMPS. New two-color foldout bulletin describes and illustrates new high-pressure centrifugal boiler-feed pumps. Cross-section diagrams and performance and data tables included. Construction features given. *Jacuzzi Bros., Inc.*

IT'S NEW ✓ CHECK IT

(19) STEAM AND WATER MIXER. A new steam and water mixer to provide hot water at isolated points is described in two-color catalog. Material emphasizes that unit eliminates piping of hot water long distances. Cutaway photographs show operation, installation, and construction. *Sarco Co.*

IT'S NEW ✓ CHECK IT

(20) BALL-BEARING SWIVEL JOINTS. New 48-page catalog features the introduction of a color code for easy identification of each type of swivel joint according to its pressure capacity. Cutaway views show design and construction of basic types. Packing units are fully illustrated and described. Weights and designs are shown for all joints. *Chiksan Co.*

IT'S NEW ✓ CHECK IT

(21) NICKEL ALLOY STEELS. The mechanical properties of heat-treated wrought steels are covered in 26-page bulletin. It contains new data, largely in the form of charts, on the properties of the more commonly used engineering steels containing up to 5 per cent nickel. Detailed information on heat-treatment methods, both for carburizing and direct hardening compositions, is given along with suggested applications. *International Nickel Co.*

IT'S NEW ✓ CHECK IT

(22) FORGED-STEEL VALVES. New 16-page catalog describes an entire line of 600-lb. forged steel valves in gates, globes, angles, and checks with various types of trim. Valves are in screwed, flanged, and socket-weld types. Describes design and construction, materials, ratings and markings. *Ohio Injector Co.*

IT'S NEW ✓ CHECK IT

(23) CARBON MONOXIDE INDICATOR. Descriptive material covers carbon monoxide indicator for accurately establishing the amount of carbon monoxide poisoning in the air. Color in indicator tube darkens according to the amount of CO in the air. Chart shows physical effects after exposure of from 1 to 8 hours. *United States Safety Service Co.*

IT'S NEW ✓ CHECK IT

The Oil and Gas Equipment Digest presents a review of what is new in equipment and trade literature . . . makes it possible for readers to obtain full information on every subject by use of convenient "Check It—Mail It" service card. This periodic feature of The Oil and Gas Journal will include all that is new in equipment . . . at a time when new products are being introduced, and existing products improved.

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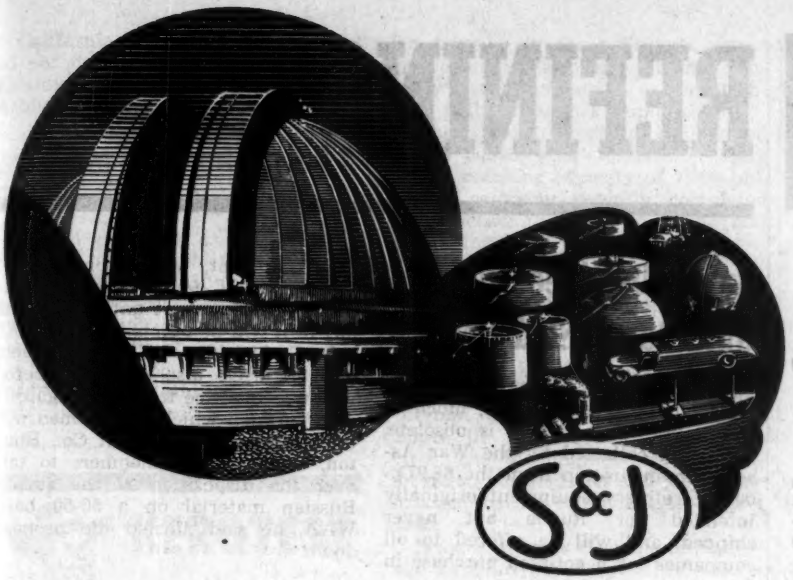

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REFINING

Russia-Destined Refinery Units to Be Sold Here

WASHINGTON.—Seven or eight complete refinery units, much of the equipment in which is obsolete, are being collected by the War Assets Administration from the $6,971,000 of refinery equipment originally intended for Russia but never shipped, and will be offered to oil companies for negotiated purchase in June.

WAA's intention to dispose of this equipment, left over when "pipe-line" shipments to Russia were halted last year, was disclosed April 15 to a House subcommittee on surplus property headed by Rep. Ross Rizley of Oklahoma.

Calling WAA, State Department and Bureau of Federal Supply officials before him to explain what had been done with some $17,000,000 worth of equipment produced for Russia and held up in this country when Congress called a halt to shipments to the Soviet, Rizley charged that the federal Government already has paid between $9,000,000 and $10,000,000 in royalties to Houdry and other patent owners.

C. Tyler Wood, deputy to the Assistant Secretary of State for Economic Affairs, denied that the amount invloved was that much, placing it at something under $1,350,000 plus a $409,000 payment to Houdry which the Comptroller General has ordered recovered since the equipment never has been put into use.

Wood disclosed, too, that the Soviet Government, in negotiating a settlement of its indebtedness to the United States, has sought a reduction in amount because some of the equipment shipped was incomplete. Four complete refineries and some additions were shipped under lend-lease and the pipe-line agreement, three of them now being in operation. With respect to royalties, Wood said the United States assumed them on goods shipped during the war for an 18-month period. On subsequent shipments the Russians were to pay the royalties, one-third on delivery, one-third when the equipment went on stream and one-third 6 months thereafter, and refinery equipment was not included in the pipe-line arrangement until Russia agreed to make the payments.

Practically every oil company in the country is interested in securing the equipment, which apparently is most valuable for replacement purposes, and it is not anticipated that any of it will be purchased for export.

D. G. Strickler, Washington chemical engineer, also appeared before the subcommittee to testify regarding a corporation which was formed with the Petroleum Equipment Co., Houston, as one of its members to take over the disposition of the surplus Russian material on a 50-50 basis. WAA, he said, turned the proposal down.

Skelly Plans New Units At Eldorado, Kans., Plant

Skelly Oil Co. board of directors has approved plans to install a 30,000-bbl. capacity crude-distillation unit and a catalytic cracking unit at the company's Eldorado, Kans., refinery. The crude unit will replace the existing 25,000-bbl. facilities and the cracking unit will augment the present thermal cracking equipment. Completion is expected by January 1950.

More than 40,000 bbl. per day of refined petroleum products will be provided by Skelly from this refinery, the two at Longview, Tex., and Denver, and the company's 13 natural-gasoline plants.

Shell, California Refining Will Expand Facilities

NEW YORK.—Long-range plans for expanding East Coast refining facilities by Shell Oil Co., Inc., and by California Refining Co. have been made public here. Shell officials are studying several sites for a refinery including the Woodbridge and Carteret areas in New Jersey.

Shell officials, however, state that no further plans can be disclosed at present. Developments are in the preliminary stages; the exact make-up of the refinery has not been determined as yet, and other plans are similarly incomplete, they say.

While no immediate plans are under way for construction of additional refining capacity at the California Refining — Barber Asphalt Corp. refinery at Perth Amboy, now operating with a rated capacity of 15,000 bbl. per day, zoning ordinances are being revised by local authorities to permit such construction if and when desired. Unofficial sources estimated that $25,000,000 may be expended eventually for additional facilities.

California Refining Co. is owned 55 per cent by Standard Oil Co. of California, and 45 per cent by Barber Asphalt Co.

Montreal Fluid Unit to Be Completed Next Year

British American Oil Co., Ltd., is planning to complete installation of a fluid catalytic cracking unit in its Montreal refinery some time late next year, according to A. L. Ellsworth, chairman of the board.

Ellsworth, in the company's annual report, says the addition of the new unit and other facilities will provide an increase in the refinery's output sufficient to take care of the company's requirements in eastern Canada without further imports.

The refinery at present has a rated crude capacity of 15,000 bbl. daily and a cracking capacity of 7,500 bbl.

The company recently completed construction of a new blending and packaging plant at Clarkson.

Work on Socony Plant in East St. Louis Under Way

Construction is now under way on Socony-Vacuum Oil Co., Inc.'s, crude thermal cracking unit at East St. Louis, Ill. Bechtel Corp., San Francisco, has the engineering and construction contracts for the job, which is scheduled for completion in August 1949.

Besides the new cracking unit, storage facilities will be installed whereby the capacity will be increased 50 per cent, or an additional 42,000,000 gal. Modernization, rehabilitation and replacement work is included in the program. Capacity of the refinery will be increased from 21,000 to 30,000 bbl. daily.

Two other projects for Socony-Vacuum are now under construction and are scheduled for completion January 1949. A Thermofor catalytic cracking unit and modernization program is under way at Casper, Wyo. Construction contract is with Catalytic Construction Co. At Paulsboro, N. J., a crude and lube plant is under construction. Engineering and building contract for this project is with E. B. Badger & Sons Co.

A.P.I. Group Will Study Technical Societies Aims

The activities and objectives of many technical societies as related to lubricants and lubrication will be the topic of a symposium at the final session of the meeting of the American Petroleum Institute Lubrication Committee to be held at the Mayo Hotel, Tulsa, April 27-28.

Speakers at the 2-day meeting will include: P. G. Exline, Tulsa, Lubricants Coordinating Committee, American Society of Mechanical Engineers; O. L. Maag, Timken, Ohio, president of the American Society of Lubrication Engineers; L. C. Beard, Jr., New York, vice chairman of Committee D-2 of the American Society for Testing Materials; R. J. S. Pigott, Pittsburgh, president of the Society of Automotive Engineers; and J. M. Koch, Oil City, Pa., member of the executive committee, A.P.I. Lubrication Committee.

Col. G. H. Vogel, Military Services Petroleum Board, Washington, and A. J. McIntosh, Socony-Vacuum Oil Co., Inc., will address the group on the increased military demand for lubricants.

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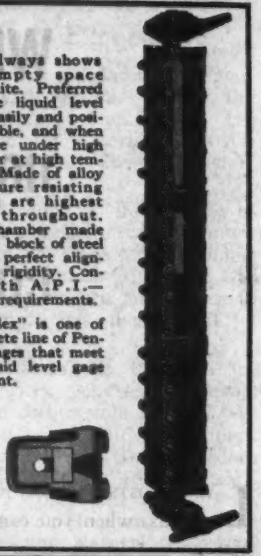
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is one of the 129 members of The Associated Business Papers, whose chief purpose is to maintain the highest standards of editorial helpfulness—for the benefit of reader and advertiser alike.

NATURAL GAS

Contracts Awarded for Natural-Gasoline Plants

Walco Engineering & Construction Co., O. L. Olsen Construction Co., and Hudson Engineering Corp. have been awarded contracts by Warren Petroleum Corp. for construction of natural-gasoline manufacturing facilities in Texas and Oklahoma.

Walco will build a 30,000-gal. capacity absorption plant at Taylor's Corner, Tex. Olsen will build a 20,000-gal. absorption plant at Jacksboro, Tex., and Hudson will install a 20,000-gal propane - manufacturing unit at Madill, Okla. All three plants are scheduled for completion by January 1, 1949.

Delhi Will Sell Gas To El Paso Natural

HOUSTON.—El Paso Natural Gas Co. has contracted with Delhi Oil Corp., Dallas, for the purchase of 100,000,000 cu. ft. daily of natural gas from Barker Dome field, San Juan County, New Mexico.

The gas from Barker Dome will be used to supply the new pipe line which El Paso Natural is preparing to construct from the area to near Needles, Calif. El Paso Natural, which last year completed a line from West Texas to California to supply the Southern California market, is under contract to furnish Pacific Gas & Electric Co. 300,000,000 cu. ft. daily near Needles for transporting and marketing in Northern California.

Delhi Oil has extensive reserves in Barker Dome. The new line from the field to Needles will be 460 miles long and will cost about $30,000,000.

Andrews Heads Stanolind's Pettus Plant Construction

A. C. Andrews, superintendent of Stanolind Oil & Gas Co.'s Hastings natural gasoline plant at Alvin, Tex., has been named field project engineer to supervise construction of Stanolind's Burnell-North Pettus cycling plant at Pettus, Tex., which is scheduled to get under way this month. C. W. Award, formerly operating engineer at the Hastings plant, will replace Andrews as plant superintendent there.

Estimated cost of the plant which is expected to be completed by April 1949, is $7,259,000. Capacity of the plant will be 166,000,000 cu. ft. daily with an expected production of 287,000 gal. daily of liquid hydrocarbons, including 150,000 gal. of gasoline, 119,000 of butane-propane, and 18,000 gal. of kerosine and diesel fuel.

Union Producing Co. will operate the producing facilities serving the plant. *(For additional information, see The Oil and Gas Journal, March 25, page 223).*

Chicago Gas Institute Offers Fellowships

The Institute of Gas Technology, Chicago, is receiving applications for graduate fellowships. A 2-year program leads to the degree of master of gas technology, and students who demonstrate marked ability are encouraged to continue in the full 4-year program which leads to the degree of Ph.D. in gas technology.

Summer employment training in the gas industry is required. Fellows receive $125 per month and are entitled to any veteran allowances they may have coming. Those interested may apply to E. S. Pettyjohn, director, Institute of Gas Technology, 3300 South Federal Street, Chicago.

Hope Will Up Capacity To 200,000,000 Cu. Ft.

Hope Natural Gas Co. has been authorized by the Federal Power Commission to construct and operate additional facilities to increase its capacity to 200,000,000 cu. ft. daily. It proposes to purchase the additional gas from Tennessee Gas Transmission Co. for further transmission and resale to customers in the Appalachian area.

Facilities will include addition of three 1,000 hp. units to Hope's Cornwall compressor station in West Virginia and construction of about 26 miles of 14-in. loop line to complete looping of a high-pressure line between the Cornwall and Hastings compressor stations. Estimated cost has been set at $1,480,000.

Kansas Group to Seek Well-Head Price Hike

The Southwest Kansas Royalty Owners Association has announced it will seek an increase in well-head prices for Hugoton field gas through an appeal to the Kansas Corporation Commission.

According to the association, "gas should be worth 10 cents per thousand cubic feet at the well-head, based on the price received for other fuels." Association directors recommended a standard $1 per rod charge by landowners for pipe-line right-of-way.

Attendance at A.G.A. Meet In Houston to Exceed 700

More than 700 gas industry executives are expected to attend the spring meeting of the natural gas department of the American Gas Association at the Rice Hotel, Houston, May 4-5.

Reports included on the 2-day program, which has been arranged under the direction of Robert W. Hendee, president of Colorado Interstate Gas Co., and vice president and chairman of the natural gas department of A.G.A., are:

"The Tidelands Oil Case," Price Daniel, attorney general of Texas; "Progress in Nationwide Natural Gas Conservation," D. A. Hulcy, president of Lone Star Gas Co., Dallas; "Flare Gas and Its Relation to Reserves," Paul Kayser, president of El Paso Natural Gas Co., Houston; and "Ten Years Under the Natural Gas Act," William A. Doutherty, attorney, New York.

Hudson W. Reed, president of Philadelphia Gas Works Co. and president of the American Gas Association, will report on plans and objectives of the association. E. S. Pettyjohn, director of the Institute of Gas Technology, Chicago, will report on research progress under the industry's coordinated program.

Highlighting the second day of the meeting will be a technicolor film, "Westward Flow," depicting construction of the natural gas line from the Texas fields to the Los Angeles area.

Expansion Authorization Granted Tennessee Gas

Federal Power Commission authorization has been granted Tennessee Gas Transmission Co. to construct and operate facilities to increase its delivery capacity to approximately 660,000,000 cu. ft. daily with the provision that these facilities not be used for the transportation or sale of natural gas except upon specific authorization by the commission.

Cost of the project is estimated at $11,739,500. Facilities will include approximately 150 miles of 30-in. mainline loop and the addition of 10,000 hp. to existing compressor stations. Such expansion will enable Tennessee Gas to deliver to United Fuel Gas Co. and Hope Natural Gas Co. the so-called option gas of 50,000,000 and 35,000,000 cu. ft. daily, respectively, and also to meet expected demands of other customers.

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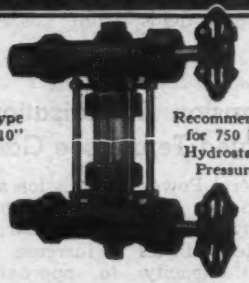

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PIPE LINES

Continental Starts Line To Ringgold-Joyce Area

Continental Oil Co. has started construction of a 6-in. pipe line from a point 3 miles east of the Continental refinery at Wichita Falls to extend eastward 16 miles to the Ringgold-Joy junction of the company's line north of Joy in Clay County.

The line will connect with a 4-in. line from Clay County pools to the south. The new line, estimated to cost $150,000, will increase capacity of the system to more than 12,000 bbl. daily.

Kentucky West Virginia Rate Hearing Set May 24

The proposed changes in rate schedules by Kentucky West Virginia Gas Co. for sales to Pittsburgh & West Virginia Gas Co. and Louisville Gas & Electric Co. will be considered in a hearing set by the Federal Power Commission for May 24.

The proposed schedules permit a reduction to 1,000 B.t.u. per cubic foot in the heat content of the gas supplied to Pittsburgh & West Virginia and the Louisville companies.

Pittsburgh & West Virginia sells gas for resale to 14 customers and also supplies gas at retail to nine West Virginia communities. Louisville Gas & Electric operates as a gas and electric distributor in a number of communities.

Humble Enlarges Lines In Throckmorton Area

In revamping part of its gathering system in southern Throckmorton County, Texas, Humble Pipe Line Co. has laid 4-in. pipe to replace temporary 2½-in. lines. This work has been done, according to reports, between a point on its main line near the Throckmorton - Stephens counties boundary and the Snowden Bailes and Marrs areas.

Progress Being Made On Creole Pipe Line

Construction in Venezuela of the Ule-Amuay pipe line, begun by Creole Petroleum Corp. March 16, is progressing at the rate of about ¾ mile per day.

The line, of 24 and 26-in. diameter, will transport about 48,000 cu. m. (about 300,000 bbl.) of crude oil daily from Lake Maracaibo fields to the Amuay Bay refinery. It is scheduled for completion late this year.

During 1947 expenditures for this line and expansion of pipe-line fa-

Operations for welding a mile section of aluminum pipe for Interstate Oil Pipe Line Co., south of Magnolia, Ark. Left: Welding by inert-gas arc-welding process utilizing two kinds of alternating current and an argon gas cloud fed around a tungsten electrode contained in a water-cooled head. Below: Supervisors of the Interstate company and Aluminum Co. of America and pipe-line visitors in foreground; welding machine in the rear

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SURVEYING & MAPPING

PIPE LINE SURVEYS

cilities for other foreign affiliates of Standard Oil Co. (N.J.) totaled $27,000,000. An additional $20,000,000 was spent by the parent company and affiliates to increase pipe-line mileage and petroleum storage facilities in the United States.

Five of the affiliated pipe-line companies moved nearly 1,000,000 bbl. of crude oil and refined products daily to consumer distribution points. This includes oil and products of other shippers. Standard and its affiliates during the year added 200 miles of trunk pipe lines to their system for a total of 11,200 miles.

Salt Lake Lets Contract For 182-Mile Rangely Line

Salt Lake Pipe Line Co. has awarded contract to Pacific Pipe Line & Engineers, Ltd., for laying the 182-mile Rangely, Colo.-Salt Lake City, Utah, crude-oil pipe line. This was announced by C. E. Finney, Jr., president, Salt Lake Pipe Line Co., a subsidiary of Standard Oil Co. of California.

The line, consisting of approximately 167 miles of 10-in. and 14 miles of 8-in., has been estimated to cost $5,000,000. The initial capacity of 25,000 bbl. daily may be increased later to 35,000 bbl. The line will deliver Rangely crude to a $5,000,000 refinery being built by another subsidiary at Salt Lake City. The pipe line is scheduled for completion November 1.

Panhandle Eastern Plans 26-In. Loops

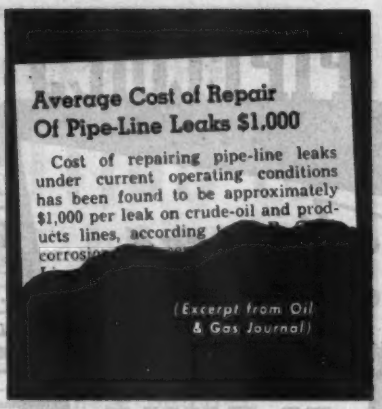
Panhandle Eastern Pipe Line Co. is contemplating letting contracts within the next 60 days for the laying of 198.5 miles of 26-in. loops on which construction will start in August. Next year the company plans to lay 168.9 miles of loops. In addition to the 1948-49 programs totaling 367 miles of 26-in. looping, the company plans to lay 335 miles of 26-in. loops later.

The entire length of the overland route of the Panhandle Eastern big-inch main line from Liberal, Kans., to Detroit, Mich., extends for a distance of 1,053 miles. In addition the company's line from Sneed station, near Amarillo, Tex., to Liberal is 106 miles long.

Texas Eastern Plans Pipe-Laying Projects

Texas Eastern Transmission Corp. has authorized the construction of three lines, for which announcements have not yet been received regarding the contracting of pipe laying.

These projects include the following: Skippack to the vicinity of Cheltanham, Pa., 20.45 miles of 12¾-in.; Broadaxe Junction to the vicinity


Average Cost of Repair
Of Pipe-Line Leaks $1,000
Cost of repairing pipe-line leaks under current operating conditions has been found to be approximately $1,000 per leak on crude-oil and products lines, according
(Excerpt from Oil & Gas Journal)

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of West Conshohocken, Pa., 6.09 miles of 8⅝-in.; and a short line from a point near the place where the Sinclair products line crosses the Texas Eastern Transmission system to the vicinity of Chester, Pa, 1½ miles of 6⅝-in.

Shell to Increase Capacity Of Illinois-Ohio Line

Shell Oil Co., Inc., has a products-line improvement program under way to raise line pressure from 1,000 to 1,200 psi., thereby increasing throughput an additional 4,000 bbl. daily for the company's refined-products system extending east from Wood River, Ill.

The line was originally designed for a capacity of 16,000 bbl. daily but was carrying 25,000 bbl. within the first year of operation.

United Gas Planning 195-Mile Program

United Gas Pipe Line Co. has planned the construction of approximately 195 miles of line this year. Three projects for which contracts have not been made, according to recent information, include the following:

For looping a portion of the existing Latex-Fort Worth main line, four loops will be laid totaling approximately 30 miles of 12-in., 14-in., 16-in., and 18-in. Part of the Latex-Fort Worth main line will be replaced by 18.5 miles of 18-in. A 93-mile, 18-in. loop line will be laid around the south side of New Orleans.

A 14.5 mile, 16-in. is now being laid for United by Associated Contractors & Engineers, Inc., from the Soso, Miss., field to the Jackson-Mobile 16-in. line. During the first quarter of this year construction consisted of a 4.7-mile 12-in. loop laid by O. C. Whitaker Co. in connection with the existing 8-in. line to Handley, Tex., and a 9-mile section of 16-in. laid by B & M Construction Co. to replace 12-in. in the Mobile-Pensacola line.

Atlantic, Virginia Gas Seek New Facilities

An amended application for authorization to construct additional natural-gas pipe-line facilities by Atlantic Seaboard Corp. and Virginia Gas Transmission Corp. has been scheduled by Federal Power Commission for a hearing May 10.

Proposed facilities include construction of 269 miles of 26-in. gas-transmission line from near Clendenin, W. Va., to a connection with the 20-in. main line of Atlantic at Rockville, Md., and construction of five measuring stations.

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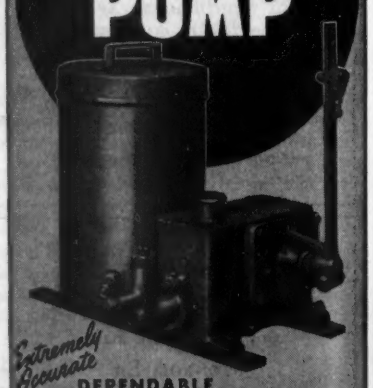
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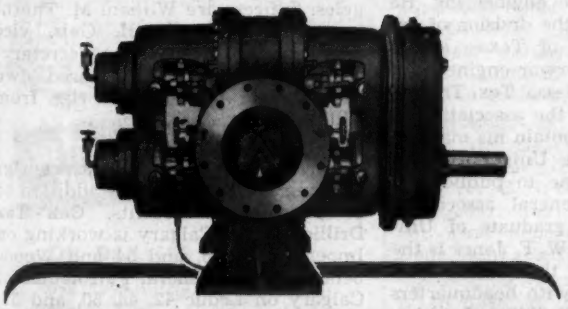

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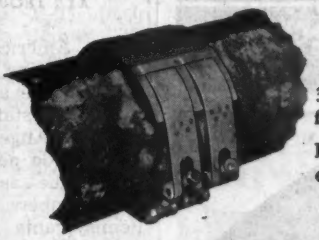

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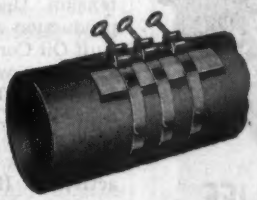

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Among the Drilling Contractors

A.A.O.D.C. NAMES THREE TO NEW POSTS

KYE TROUT, JR. THOMAS J. YOUNG W. F. JONES

The American Association of Oilwell Drilling Contractors has announced the addition of two men to its Dallas staff, and a secretary in the Los Angeles office. Kye Trout, Jr., will do general liaison work between the association headquarters and members. Trout graduated from Pennsylvania State College with a degree in petroleum engineering. He was formerly with the division of extension, University of Texas, and a production and reservoir engineer for Gulf Oil Corp. at Odessa, Tex. Thomas J. Young, who left the association in September 1947 to obtain his master's degree at Columbia University, will now devote his time to public-relations work and general association activities. He is a graduate of University of Missouri. W. F. Jones is the new secretary of the association's California chapter, with headquarters in the Halliburton Building, Los Angeles. He was formerly a drilling contractor and will handle all matters pertaining to that chapter.

Safety Clinic Scheduled

The third annual Drilling Industry Safety Clinic is scheduled for July 6-7, at the Baker Hotel, Dallas. Reservations may be made through the American Association of Oilwell Drilling Contractors, Gulf States Building, Dallas.

Frank Saddler has contracted to drill three 2,600-ft. tests for Johnston Drilling Co., Inc., in 6-7s-11w, Vanderburgh County, Indiana.

New Los Angeles Firm

Thornbury Drilling Co., a recently organized firm, has headquarters at 510 South Spring Street, Los Angeles. Officers are William M. Thornbury, president; W. H. Geis, vice president, and Fred Bryce, secretary-treasurer. Firm has acquired two 5,000-ft. and two 6,500-ft. rigs from William Thornbury, Inc.

Imperial Oil has 15 contract rigs working in Leduc field in addition to company-owned outfits. **Can-Tex Drilling Co.** of Calgary is working on Imperials 24, 46, and 54 and Woodbend 2 and 3; **General Petroleums** of Calgary on Leduc 42, 48, 50, and 57; **Drilling Contractors, Ltd.**, of Calgary on Leduc 47, 51, 52, and 56, and **Commonwealth Drilling Co.** of Calgary on Leduc 49 and 53. Additional contracts are being let.

O'Rourke-Baker Drilling Co., Tulsa, has contract for a Kay County, Oklahoma, wildcat, the R. E. Dirickson and C. A. Palmer 1 Engelking, SE SE SE 33-29n-3e, northeast of Newkirk.

Mallard Drilling Co., Wichita, has been awarded contract for a McPherson County, Kansas, wildcat, Lotus Oil Co. 1 Sinden, NW NW NE 15-20-3, 1½ miles southwest of Johnson pool, and 3 miles southeast of McPherson.

Tiger Tooth
TONG DIES

Web Wilson "TIGER TOOTH" Tong Dies have a pyramidal, pointed tooth pattern that assures a positive, "biting" grip on the hardest tool-joints under the strongest pulls. Especially recommended for flame-hardened and hard metal surfaced tool joints or wear subs. The sloping sides and heavy base of the pyramidal shaped teeth gives extra strength and backing to each tooth. Tiger Tooth Tong Dies will not easily break down even in severe service. They are of the "full-length" design that completely fills die slot in the tong and are reversible to provide extra service life..."TIGER TOOTH" Tong Dies will fit all tongs used in the oil fields today—for dependable, economical service, specify WEB WILSON "TIGER TOOTH" TONG DIES.

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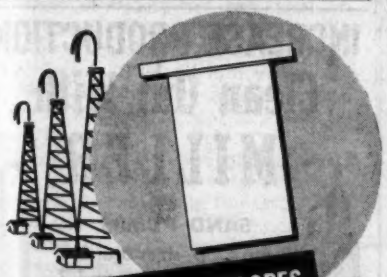

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Deardorf Drilling Corp. Oklahoma City

Growth.—Deardorf Drilling Corp. is one of the newest drilling concerns in Oklahoma City. Organized in March 1948, the firm has two rotary rigs in operation. A new rig, designed for drilling to 8,000 ft., is now drilling at Deardorf Oil Corp. 1 Tickle in southeastern Oklahoma County. The other rig, equipped to handle wells to 5,000 ft., has been moved from the Prague area in Pottawatomie County, Oklahoma, to a location in St. Louis pool in the same county. The drilling corporation was created primarily to drill wells for Deardorf Oil Corp., which was organized in 1947 by B. C. Deardorf. Two additional rigs will be purchased under present plans. Deardorf Oil Corp. plans to drill about 15 wildcats during the remainder of 1948 in addition to normal development on proven acreage.

B. C. DEARDORF

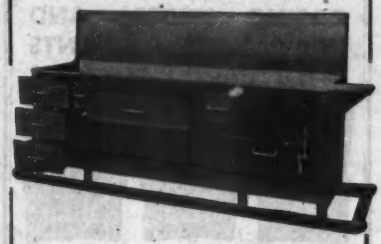
W. A. DUTTON

Personnel.—B. C. Deardorf, president; William A. Dutton, vice president; Harriette R. Brooks, secretary-treasurer; E. N. Brockman, chief geologist; Earl Ingram, Jr., superintendent, land department; and Charles Donaldson, attorney.

Sidelights.—Operating independently in 1946, B. C. Deardorf opened Grief Creek and Northeast Holdenville pools in Hughes County, Oklahoma. . . . Since the organization of Deardorf Oil Corp. in April 1947, the following productive areas in Oklahoma have been opened: Merhoff area near Kildare, Kay County; Turner area in the St. Louis district, Pottawatomie County; Abbie Conner area in the Jennings-Oilton district, Creek County; the Prague extension area, Pottawatomie County; and Northeast Sporn pool, Payne County. . . . Glen Armour is production superintendent for Deardorf Oil Corp. William A. Dutton was drilling superintendent for Manning & Martin, Inc., for 7 years. . . . New offices in Fidelity Na-

OWEN

SAVE YOUR TOOLS — LOWER YOUR COSTS



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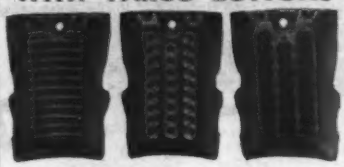

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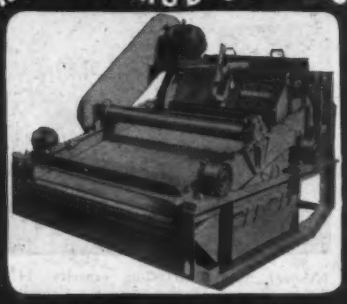

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tional Bank building in Oklahoma City have been occupied by the two firms.

C & L Drilling Co. has started E. A. Chamberlain 1 Boone, wildcat in SW 25-11n-11w, 2 miles north and 1 mile west of Lake Enid field, DeSoto Parish, North Louisiana. Contract is for 3,200 ft.

Prime Drilling Co., Oklahoma City, has been granted an Oklahoma charter with $100,000 capital stock. Incorporators are C. A. Prichard, M. G. Prichard, and E. S. Wells, all of Oklahoma City.

Hayes Drilling Co., Mt. Carmel, Ill., has contract for a 2,400-ft. test, P. N. Wiggins, Jr., 1 State Life Insurance Co., 330 ft. from north and west lines, NW 22-1s-12w, Knox County, Indiana.

Cook Drilling Co., Fort Worth, has contract for Carter Oil Co. 1 H. H. Gildon, 22-16s-27w, Miller County, Arkansas. Scheduled depth is around 9,000 ft., which is expected to penetrate Smackover limestone. Nearest production is Fouke field, 3½ miles southeast of location. Drilling is to start as soon as materials are available.

Seran Drilling Co., Okemah, Okla., is contractor for a Hunton lime test in Carey pool sector, Okfuskee County, Oklahoma, Gulf Coast Western Oil Co. et al 1 Ball, SE NW SW 27-12n-10e.

Sam Malis, Owensboro, Ky., will drill Leo Angermeier 1 Esther O. Strack, 330 ft. from south and west lines, SW NW NW 29-6s-13w, Posey County, Indiana.

Davis & Stewart Drilling Co., Wichita Falls, Tex., is putting down a 4,500-ft. test in Seminole County, Oklahoma, its 1 Pendley, SW NW SE 1-8n-5e.

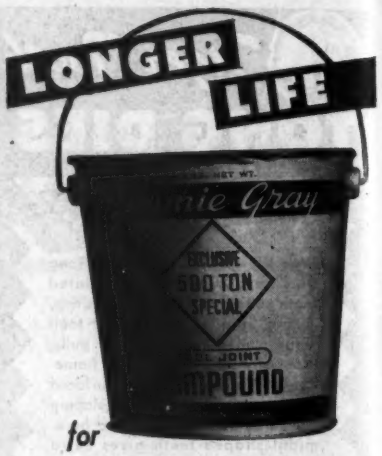
Iron Drilling Co., Tulsa, will drill Darby & Bothwell, Inc., 1 Geibler, wildcat in SE SE SE 10-13-17, 1 mile southeast of Catherine pool, Ellis County, Kansas.

Ed Davis, Abilene, Tex., will drill a 6,250-ft. test for Hickok & Reynolds, Inc., the 1 E. C. Rawlings, Section 435, Block 1-A, H&TC Survey, Coke County, West Texas.

Tannor Drilling Co., Shreveport, is drilling Joseph T. Bell 1 Cone Estate, wildcat in C SW NW 23-16s-5w, Desha Basin, Ashley County, Arkansas.

Clay Eubank, Franklin, Ky., is drilling an 1,800-ft. cable-tool test for the newly organized Cumberland Oil & Gas Co., Marion, Ky. Test is 1 Ray Linzy, 1 mile east of Dycusburg, Crittenden County, Kentucky.

LONGER LIFE



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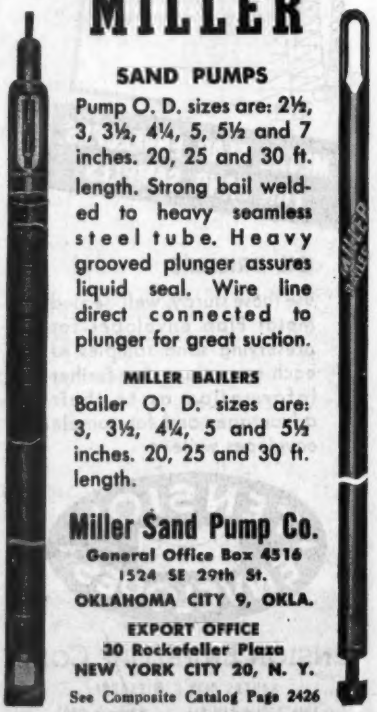

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See Composite Catalog Page 2426

REPORTS ON

Exploration and Drilling

Geophysical Society Is 18 Years Old

THAT petroleum is a progressive industry is not news to those working in it; and it came as a shock when we were informed by the public-relations experts that the public was not aware of it. One of the best examples of taking things for granted is the case of the Society of Exploration Geophysicists.

Nowadays when an oil man talks about a "doodlebug" he may mean one of two things. He may mean, as he undoubtedly would have meant 20 years ago, to refer with scorn to some alleged magic mumbo-jumbo device for which claims were made that it could do everything but talk when it came to finding oil. Then there would have been no question of his meaning. Today, depending on the tone of voice, he may well be referring affectionately to one of the modern geophysical instruments which has just helped him to find an oil field; or which he intends to use to check a block of leases where he hopes to find an oil field.

While geophysics and geophysicists were used to some extent in the twenties, and mostly in the late twenties of this century, it was not until 1930 that there was enough assurance and recognition of need for the geophysicists to band together in a group dealing only with oil. The original charter membership of S.E.G. totaled up to the huge number of 29 men. Eighteen years later the membership has passed the 1,600 mark.

Of these, probably about 500 to 600 will attend the annual convention in Denver next week. Most of the other members will hear some of the Denver papers at some time during the year, at one or more of the six local sections which have been organized within the past 2 years. Local sections have now been organized in Tulsa, Shreveport, Houston, Dallas, Fort Worth, and Los Angeles.

During the recent war, geophysicists carried a double burden. In the early stages when the importance of and need for oil exploration was not completely appreciated, many of them went into military research work. As a new profession, the average age was young, and a very high percentage were subject to the draft. After the need for more exploration became urgent, the War Manpower Commission and draft authorities had a hard time understanding why so many young men could be so important to the industry.

Rapid changes are taking place in the field of geophysics, and among the members. One of the most significant is the abandonment of ultra secrecy, common only a few years ago. Like other professional men before them, they learned the great advantages of more open discussion of common problems. Even more significant is the shift in the attitude toward their fellow exploration scientists, the geologists and sedimentologists. The die-hard geologist who would have nothing to do with the "doodlebugs" has about disappeared; so has the cocky young geophysicist who thought his instruments knew all the answers. Now they know they need each other to solve the problems.

HIGHLIGHTS OF WEEK'S DEVELOPMENTS

ROCKY MOUNTAIN.—Continental Oil Co. has spudded the Taylor-Sussex wildcat, north of Salt Creek in 17-42n-78w, Johnson County, Wyoming, as the first of several important tests to be drilled in the Powder River Basin this year. Also in Wyoming, Pure Oil Co. is drilling below 14,130 ft. at the deep West Poison Spider test, Natrona County, and Continental is retesting its discovery of last year at South Shoshone in Park County.

NORTH TEXAS.—In southeastern Hale County, General American Oil Co. has staked four offsets to the 1 Byrd, new Pennsylvanian limestone discovery.

CALIFORNIA.—General Petroleum Corp. extends Cat Canyon field of Santa Barbara County with the 46-22 Los Flores which pumped 160 bbl. of oil per day from total depth of 6,146 ft.

SOUTH LOUISIANA.—After encountering oil sands at 13,110 ft. and 13,140 ft., Stanolind Oil & Gas Co. is drilling ahead below 13,303 ft. at the 1 Trahan, second Florence area test, Vermilion Parish. Magnolia Petroleum Co.'s confirmation well of its new Hurricane Creek field gaged 129 bbl. of oil per day.

NORTH CENTRAL TEXAS.—Star Oil Co.'s rank wildcat in Callahan County, the 1-A Brown, recovers gas and 215 ft. of oil-cut mud on drill-stem test at 4,467-83 ft. to become a prospective Ellenburger discovery.

CANADA.—Imperial-Woodbend 1, LSD 5, 15-51-26w4, 3½ miles northwest of the Leduc main field, produces 143 bbl. of oil daily. The field is also extended to the southeast by Imperial 9, LSD 16, 3-50-26w4, and Okalta-Leduc 2, LSD 10, 33-49-26w4, and to the west by Globe-Leduc 7, LSD 5, 19-50-26w4.

SOUTHWEST TEXAS.—Coastal Refineries, Inc., et al 1-B Pena, oil discovery in southeastern Starr County, gaged over 38 bbl. 42.5°-gravity oil per day with no water.

MID-CONTINENT.—In McPherson County, Kansas, an old dry hole reworked appears to be a new pool opener. Westgate-Greenland Oil Co. et al 1 Ruth, 13-18s-1w, had 1,300 ft. of oil and 100 ft. of water in the hole after being cleaned out for a test. East of the Velma field in Stephens County, Oklahoma, Gulf Oil Corp. and Stanolind Oil & Gas Co. continues to drill at the 1 Oklahoma National Unit after recovering 4,850 ft. of oil on drill-stem test at 6,005-78 ft.

MISSISSIPPI

Simpson County May Get First Gas Producer

JACKSON.—Superior Oil Co. 1 N. V. Berry, Section 2-9n-19w, in Simpson County, north edge well in Gwinville field, had only 8 ft. of gas sand above water, and is drilling ahead to the Massive sand section. If this well is completed as a gasser, it will be Simpson County's first producer.

Gulf Refining Co. 11 J. M. Andrews, in Section 6-1n-16w, Baxterville field, Lamar County, has been completed for an initial production of 424 bbl. of 15.8°-gravity oil per day through a 15/64-in. choke with tubing pressure 650 psi., and .03 per cent b.s.&w. Total depth is 8,819 ft., with perforations at 8,665-96 ft., and 8,758-71 ft.

In LaGrange field, Adams County, James E. Kemp et al 1 Mrs. Fannie Green-Stanton, Section 90-7n-2w, was completed through perforations at 6,141-45 ft., for a potential gage of 144 bbl. of 39.1°-gravity oil per day through a 10/64-in. choke. Total depth is 6,213 ft.

Humble Oil & Refining Co. 3 Nora Sartin, 17-6n-8e, in Mallalieu field, Lincoln County, drilled to a total depth of 10,505 ft., and flowed on potential test 321 bbl. of oil in 21 hours through a 25/64-in. choke, with tubing pressure 225 psi. Production is through perforations at 10,419-46 ft.

Also in Mallalieu field, Lincoln County, The California Co. 1 Leona Kelly Reed, 20-6n-8e, was completed flowing 1,075 bbl. of 37.2°-gravity oil through a ½-in. choke. Total depth is 10,492 ft., and perforations for completion at 10,446-54 ft., and 10,474-80 ft.

In Adams County, Pine Ridge field, Phillips Petroleum Co. 3 Mrs. Vic Artman, 36-8n-2w, flowed a final gage of 163 bbl. 40.5°-gravity oil through 9/64-in. choke. Perforations were at 5,616-20 ft., and total depth was 5,710 ft.

Humble B-2 E. L. West, 24-9n-8w, in Yellow Creek field, Wayne County, drilled to a total depth of 5,130 ft., and pumped 205 bbl. of oil in 24 hours, gravity 20.1°, through perforations at 5,000-14, 5,077-91, and 5,117-75 ft.

Three new locations were reported this week, one a wildcat in Issaquena County, and one each in Baxterville field, Lamar County, and Brookhaven field, Lincoln County. One wildcat failure was reported in Greene County, while six development wells were producers.

MISSISSIPPI WILDCAT FAILURES

Greene County: Sun Oil Co. 1 David Gaines Est., 1-5n-6w, dry, TD 2,176 ft. Tops: Yazoo 705 ft., Cockfield 840 ft., nhydrite 1,305-1,595 ft.

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SOUTHWEST TEXAS

Starr County Discovery Gages 38.5 Bbl.

CORPUS CHRISTI.—Coastal Refineries, Inc., and W. D. Kennard 1-B Luis Pena, new oil discovery well in southeastern Starr County, approximately 2 miles north of Sam Fordyce field, gaged on potential test 38.5 bbl. of 42.5°-gravity oil per day with no water, through a 7/64-in. choke. Gas-oil ratio is 1,825, with tubing pressure 1,880 psi., casing pressure 2,300 psi. Production is through perforations at 5,760-75 ft., with top of sand at 5,750 ft. Total depth is 5,850 ft., with 7-in. casing set to 5,841 ft. Test is located in Porcion 38.

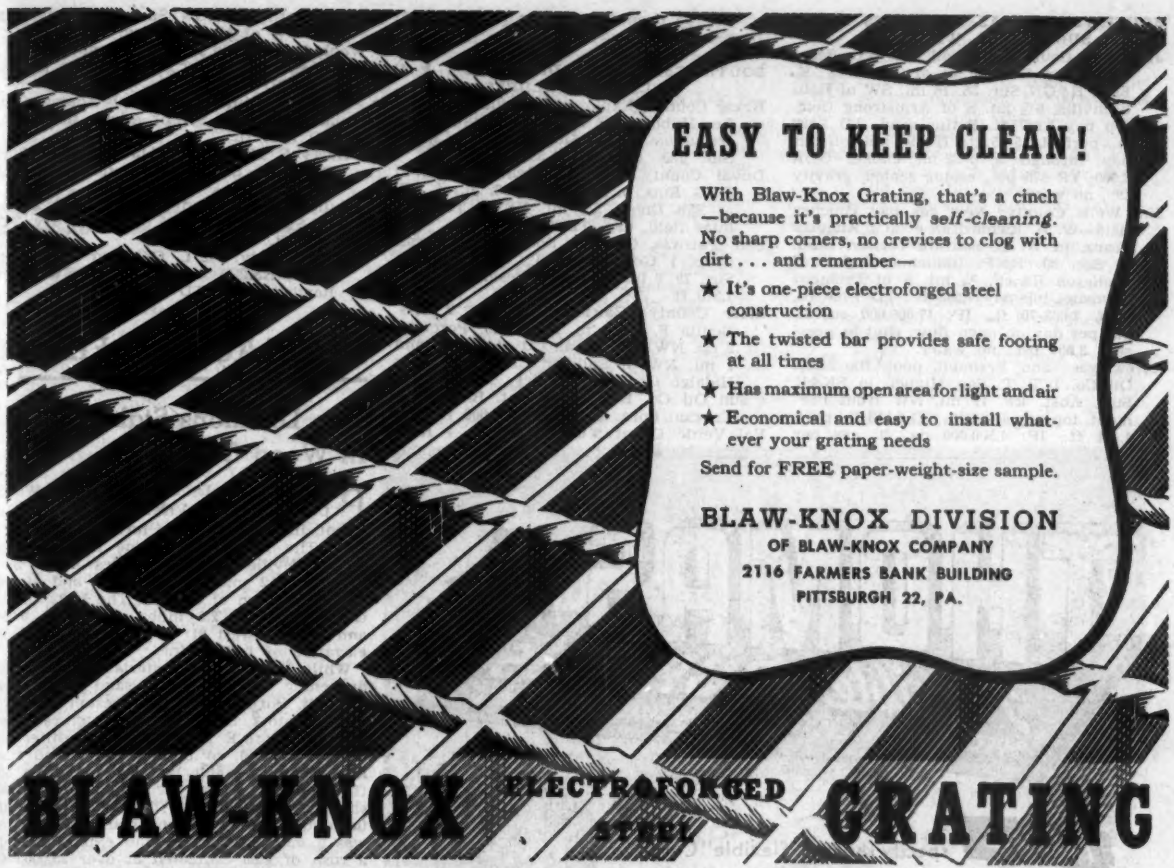
In Starr County, Kennard field, Coastal Refineries and Kennard E-6 M. M. Garcia, Porcion 93, opened a new pay sand, top of sand 3,903 ft. On potential gage the well flowed 50 bbl. of 42.4°-gravity oil per day through a 5/32-in. choke, with gas-oil ratio of 400, tubing pressure 175 psi. and casing sealed. Production is through perforations at 3,903-09 ft.

Humble Oil & Refining Co. 3 E. Block Heirs, deep-pay discovery approximately 1⅛ miles northwest of Sun field in northeastern Starr County, gaged 40.52 bbl. of 52.5°-gravity oil or condensate per day through a ⅛-in. choke. Gas-oil ratio 9,400. Production is through perforations at 8,833-48 ft. Total depth is 9,206 ft. with 5½-in. casing set to 9,202 ft.

Humble MC-1 King Ranch-West Borregas, a wildcat test in northwestern Kleberg County, approximately 4½ miles northwest of Borregas field, in R. King Survey 172, recovered 372 ft. of oil and 93 ft. of salt water on a drill-stem test at 5,958-67 ft. and is drilling ahead below 6,074 ft. in sand. Scheduled depth is 9,000 ft.

J. E. Smith 1 T. J. Caldwell, wildcat test in Bastrop County, approximately 1½ miles southeast of the Travis County line and 5 miles north of Cedar Creek, was preparing to set casing for production test after indicating discovery of oil production on a drill-stem test at 1,605-27 ft. Test was made through ⅝-in. choke and recovered 433 ft. of pipe-line oil in 40 minutes, with no water. Located in Jose A. Navarro Grant.

The 34 new locations reported for Districts 1 and 4 included 14 wildcat starts, 3 in Duval and 1 each in Aransas, Bastrop, Caldwell, Dimmit, Guadalupe, Jim Wells, Kenedy, Milam, San Patricio, Starr, and Zapata counties. Successful wildcats opened a new oil pool in Jim Hogg County, new gas pay in Blucher field and Premont field, Jim Wells County. Eleven wildcats were failures, four in Webb, two in Starr, and one each in Bexar, Duval, San Patricio, Val Verde, and Zapata counties.



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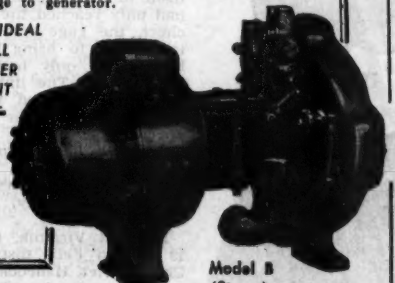

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SOUTHWEST TEXAS (DISTRICTS 1 & 4) SUCCESSFUL WILDCATS

Jim Hogg County: New oil pool San Pablo —Bairidge & King et al 3 Mrs. S. K. East, H&GN Sur. 36, 16 mi. SW of Hebbronville, 6½ mi. S of Armstrong field, top pay 3,867 ft. Pettus sand, TD 3,890 ft., perf. 3,875-85 ft., IP: 96 bbl. oil per day through a 5/32-in. choke, GOR 3,000, TP 870 psi., casing sealed, gravity 39°, no water.

Jim Wells County: New gas pay Blucher field—W. A. Richardson et al 1 Augusta Franz, in W. B. Sanford revised subd. of Sec. 30, R. P. Haldeman Subd. of Seeligson Ranch, ¾ mi. S of Premont townsite, top pay 7,663 ft., TD 7,766 ft., perf. 7,663-70 ft., IP: 17,000,000 cu. ft. gas per day on open flow, shut-in pressure 3,804 psi., no water.

New gas sand Premont pool—Barnsdall Oil Co. 1 T. T. San Miguel, in SK&K Sur., Abst. 458, 11 mi. NW from Premont, top pay 4,421 ft., TD 6,113 ft., perf. 4,421 ft., IP: 4,500,000 cu. ft. gas per day on open flow, shutin pressure 1,771 psi., no water.

SOUTHWEST TEXAS (DISTRICTS 1 & 4) WILDCAT FAILURES

Bexar County: Exploration Drilling Co. A-1 Lee Hubbard, in San Antonio Suburban Irrigation Farms Subd., William Miller Sur. 180, dry, TD 1,552 ft.

Duval County: M. L. Massingill et al 1 D. G. Ruiz, in BS&F Sur. 93, 20 mi. NW of San Diego, 3½ mi. NE of Teransahuas field, dry, TD 3,724 ft.

San Patricio County: Southern Minerals Corp. 1 Goodloe, in T. T. Williamson Sur. 79, 2 mi. NW of Ingleside, dry, TD 7,319 ft.

Starr County: Bairidge & King 2 Mrs. Benita F. Diaz, in Tract 195, Porc. 38, 2 mi. NW of Sullivan City townsite and 1 mi. NW of Sullivan City field, near Hidalgo County line, dry, TD 3,550 ft.

Sun Oil Co. B-16 Frost Nat. Bk., in Y. Trevino Porc. 96, dry, TD 6,000 ft.

Val Verde County: O. W. Killam 1 Rufe Everett, in I&GN Sur. 136, Block 1, 2 mi. SW of Mertzon, dry, TD 3,001 ft.

Webb County: Sid Katz 1 S. Benavides Est., BS&F Sur. 703, 3 mi. NE from Oilton, dry, TD 2,636 ft.

Harry E. Murray 4 Mabel Adami, Sur. 336, 1½ mi. S-SW of Adami field, dry, TD 1,420 ft.

Harry E. Murray B-1 Mabel Adami, Sur. 339, 1 mi. SW of Adami field, dry, TD 1,013 ft.

Sullivan & Creslenn 1 Laurel Bros., Block 24, Sur. 333, 2 mi. N of Oilton, dry, TD 2,035 ft.

Zapata County: W. L. Goldston 3 Ramirez et al, H&GN Sur. 7, 10 mi. SW from Randado, dry, TD 1,001 ft.

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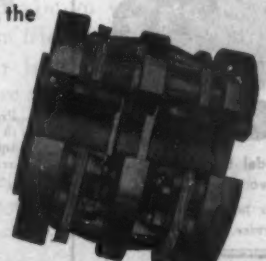

TYPE DBZ

THOMAS FLEXIBLE COUPLING CO.
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APPALACHIAN FIELD

Two Locations Staked In Wood County

PITTSBURGH.—In Steele district, Wood County, West Virginia, Godfrey L. Cabot, Inc., has locations for two new wildcats. The 1,281 John Hogue is found on the Belleville Quad 3.2 miles south 39° 0.05′ and 0.2 mile west 81° 15′ and starts at an elevation of 998.6 ft. The 1,282 Jacob Gates is found 2.5 miles south 39° 0.05′ and 4 miles west 81° 30′ and starts at an elevation of 1,035.30 ft.

While waiting for material to continue deepening to the Clinton sand 1 Virginia Cuppett, Portland district, Preston County, the operators, Snee, Eberly et al, ran the tools in 1 Cora E. Lewis, a good Corniferous chert gas well, to bottom and found the hole clear. The hole is cased to within 60 ft. of bottom. It was decided to drill ahead slightly and clean out. The tools had been in action for less than an hour when there was a muffled underground explosion and a rush of gas, estimated at over 25,000,000 cu. ft. which shut itself off and shortly cleared itself with large pieces of chert being blown out of the hole. After the initial output subsided, the tools were felt for but the line was free and when reeled out of the hole, the free end was kinked and in some places flattened to 4 in. wide. All work was halted and the gas turned in the line, again, with an increase of 800,000 cu. ft. There is no idea of where the tools lodged but the action is as of a partial bridge and until pressure drilling equipment arrives no attempt will be made to locate them.

On Chestnut Ridge in Georges Township, Fayette County, southwest Pennsylvania, New Penn Development Co. et al are preparing to clean out 1 Mary I. Smith as the gas volume has decreased to a safe point. When this well unexpectedly blew itself in in September 1946 when the tools had only reached the top of the Onondaga chert, the gage was so high that it was impossible to bring the tools out of the hole which only had a surface string of casing in it. The line was backed off the spool and dropped in the hole and the well controlled. The well has since produced some billions of cubic feet of gas.

New locations in southwest Pennsylvania totaled five and in Kiskiminitas, Kittanning, Red Bank, and Valley townships, Armstrong County; Ringgold Township, Jefferson County.

In West Virginia, new locations totaled 19 and in Falls district, Fayette County; Clay district, Hancock County; Ravenswood and Union districts, Jackson County; Cabin Creek district, Kanawha County; Harts Creek district, Lincoln County; Logan district, Logan County; Stafford district, Mingo County; Jefferson district, Nicholas County; Buchannon and Meade districts, Upshur County; Lincoln district, Wayne County; Tucker district, Wirt County; Steele district, Wood County; Baileysville district, Wyoming County.

WEST VIRGINIA WILDCAT FAILURES

Jackson County, Ravenswood district: E. M. Reynolds 1 E. L. Carmichael, dry, elev.

606 ft., Corniferous lime 4,306 ft., Oriskany 4,407-13 ft., TD 4,444 ft.

Ripley district: Godfrey L. Cabot, Inc., 1,264 T. D. Castro, dry, elev. 863 ft., Corniferous lime 5,019 ft., Oriskany 5,120 ft., shot 5,163-73 ft., gage only 21,000 cu. ft. gas, plugged, TD 5,206 ft.

TEXAS GULF COAST

New Harris Co. Discovery Gages 21 Bbl.

HOUSTON.—A new oil discovery in Harris County, Sun Oil Co. 1 Ruby Bossier, in the Frederick Rankin Survey, Abstract 57, on potential test gaged 21 bbl. of 38.8°-gravity oil per day through an 8/64-in. choke through perforations at 8,252-55 ft. Flowing pressure on the tubing was 525 psi. and gas ratio is 8,760. Total depth is 9,015 ft., with plugged-back depth at 8,300 ft. This test is located 3 miles south of Huffman townsite and on the north side of the old Crosby prospect.

Deep oil production in the Long Mott area of Calhoun County was indicated in a test of Fullerton Oil Co. & Ryan Consolidated Petroleum Co. 1 Carrie McDonald, deep test about 4 miles north of Seadrift. The test topped oil sand at 9,638 ft. while drilling, and operators took a core at 9,656-61 ft. and recovered 3 ft. of saturated oil sand. On drill-stem test at 9,645-61 ft., through ¼-in. chokes top and bottom, and using 2,300-ft. water cushion, flowed gas in 15 minutes, with 2 psi. working pressure, pulled 7 stands of drill pipe, then flowed water cushion and blew oil and gas for 15 minutes, recovering 60 ft. of 44°-gravity oil and mud, 90 ft. of oil, and 90 ft. of oil-cut mud, with a trace of salt water. Bottom-hole pressures were 4,275 psi. open and 5,225 psi. closed in. Operators are drilling ahead below 9,703 ft. This well is located in Miguel Castillo Grant.

A new oil-discovery well approximately 1 mile east-northeast of Lolita field, in Jackson County, Humble Oil & Refining Co. D-2 Four-Way Ranch, has run potential gage of 220 bbl. of 33.1°-gravity oil per day through a 5/32-in. choke, with gas-oil ratio of 716. Production is through perforations at 5,824-29 ft. Total depth is 8,700 ft. with 5½-in. casing set to 5,907 ft. Top of pay zone is 5,824 ft. Located in I&GN Survey, in Lot 86 of First Reg. Subdivision of La Ward Farms.

Grubb & Hawkins 1 Mrs. Blanche G. Rogers, wildcat exploration approximately 1 mile southwest of gas production in Bammel field, Harris County, is flowing some oil on a new test. This well is located on a 652-acre lease in WCRR Survey, Abstract 931. Well is cleaning through a ¼-in. choke, perforations at 6,420-24 ft., flowing 50 bbl. of oil plus 75 per cent brackish water which is slowly decreasing. Flowing pressure on the tubing is 660 psi. and gas-fluid ratio is 400. Total depth is 7,325 ft.

The 36 new locations for Districts 2 and 3 included 3 wildcat starts, 1 each in Fort Bend, Jackson, and Victoria counties. Two wildcats were successful opening a new oil pay in Ganado Deep pool, Jackson County, and opening a new gas pool in Victoria County. Ten wildcat failures were reported, two each in Brazoria, Jackson, and Live Oak, and one each in Matagorda, Montgomery, Refugio, and Walker counties.

TEXAS GULF COAST (DISTRICTS 2 & 3) SUCCESSFUL WILDCATS

Jackson County: New oil pay Ganado Deep pool—The Texas Co. 11 Mortagage Land & Investment Co., in Morris & Cummings Sur. 3, TD 7,678 ft., perf. 6,426-29 ft., IP: 86 bbl. oil per day through 7/64-in. choke, GOR 521, TP 750 psi., casing sealed, gravity 37.6°, no water.

Victoria County: New gas pool—Cities Service Oil Co. 1 Mrs. S. H. Baker, in Valentin Garcia Grant, 3 mi. SE of Inez and 4½ mi. N of North Keeran field, top pay 5,240 ft., Frio sand, TD 6,816 ft., perf. 5,240-49 ft., IP: 7,400,000 cu. ft. gas per day on open flow, shutin pressure 2,180 psi., no water.

TEXAS GULF COAST (DISTRICTS 2 & 3) WILDCAT FAILURES

Brazoria County: J. S. Abercrombie and Magnolia Pet. Co. 1 J. D. Kuhn Est., in Jno. Cummings League, in Old Ocean area, dry, TD 11,356 ft.

Skelly Oil Co. 1 Sigmund Stern, in Freeman Pettus Sur., in Sugar Valley area, dry, TD 11,440 ft.

Jackson County: Gulf South Oil Corp. 1 E. S. Yoas Est., in J. A. Pearche Sur. 36, 1½ mi. S of Little Kentucky field and 12 mi. SE of Ganado, dry, TD 6,525 ft.

Jackson County: Geo. Parker and W. Earl Bowe 1 Mrs. Regina S. Gayle, in Nestor Clay Sur., Abst. 13, 3 mi. W-SW of Ganado, dry, TD 6,148 ft.

Live Oak County: Argo Oil Corp. 1 Duwel Co., in AB&M Sur. 51, 4½ mi. SW of Clegg, dry, TD 3,570 ft.

Edwin B. Cox & Jake L. Hamon 1 Clay West Abbey, in Antonio Fernandez Sur. 18, in Block E, Geo. West Ranch Subd., dry, TD 3,827 ft.

Matagorda County: Baer Land Co. 1 G. Baer Estate, in Seth Ingram Sur., 2 mi. N of Old Big Hill Dome, 8 mi. NE of Matagorda townsite, dry, TD 3,613 ft.

Montgomery County: Moran Oil Co. 1 Mrs. Lelia Crawford, in Jos. Buchanan Sur., 2 mi. SW of Willis townsite, dry, TD 5,031 ft.

Refugio County: Renwar Oil Corp. 1 H. J. Friday et al, in Thos. Scott Sur., dry, TD 7,020 ft.

Walker County: Hinkle Drilling Co. and R. H. Abercrombie et al 1 J. S. Aangier, in James Tinsley Sur., 5 mi. SE

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of Huntsville townsite, 3 mi. S of Sam Houston field production, dry, TD 5,698 ft.

N. CENTRAL TEXAS

Prospective Ellenburger Well in Callahan County

WICHITA FALLS.—A prospective Ellenburger well, 6 miles south of Clyde, and about 7 miles southwest of Baird, in Callahan County, was reported at Star Oil Co. 1-A Josie Brown, Section 2, BBB&C Survey. Top of the Ellenburger was 4,434 ft., with total depth at 4,487 ft. A 35-minute drill-stem test from 4,467-83 ft. showed gas at the surface in 9 minutes and recovered 215 ft. of heavily oil-cut mud. Flowing pressure was 135 psi., increasing to 1,550 psi., when shut in 15 minutes. Operators set casing to 4,462 ft. and were to move in cable tools for completion attempt.

Eight miles north of Putnam, Tex Harvey Oil Co. plans a second well at the site of its Ellenburger discovery. The new test, to be 1 George Anthony, 2,320 ft. from north and 2,050 ft. from west lines of Section 2, D&DA Survey, is 70 ft. east of the Ellenburger producer, and is scheduled to 3,900 ft. to test the Caddo limestone, which showed for commercial production in the discovery well.

Montague County operations included the completion of a 1-mile east extension to conglomerate production in Miller field, southwest of the Stoneburg townsite. The second well, reported running higher than the discovery, had pay section at 6,144-68 ft., and made completion potential at 395.8 bbl. of 43.5°-gravity oil in 6 hours, flowing through ½-in. choke. Daily potential was rated at 1,584 bbl. Gas-oil ratio was 600 cu. ft. Continental Oil Co. 1 Ayres, approximately 1 mile south of the Miller discovery, in Section 21, encountered salt water, with some oil, from perforations at 6,130-32 ft.

New work in Montague County included S. D. Johnson 1 Claude Ayres, 480 ft. from north and 330 ft. from west lines of Block 63, ETRR Survey. Location is about 2 miles northwest of the town of Montague and southeast of the Minor Strawn sand discovery. Southwest of Montague, Continental Oil Co. staked location for 1 Montague County, as a west offset to Sinclair and Continental 1 Grenow, Strawn discovery. It is 1,400 ft. from north and 467 ft. from east lines of the Westmorland Survey. Louis Sikes made location for his 1 M. Fowler, a 7,000-ft. test 3 miles north of Stoneburg, 1,885 ft. from east and 5,290 ft. from south lines of R. M. Davis Survey, Abstract 181.

Wise County operations were: Cities Service Oil Co. 1 Berry, Chico field, was still shut down at total depth of 5,778 ft., after losing circulation. Three miles northwest of Chico, Burk Royalty et al 1 Maguire was drilling below 4,960 ft. in shale. It reported a slight oil odor between 4,693-97 ft., but did not test. Mid-Continent Petroleum Corp. 1 Kaker, 1¾ miles northwest of Bridgeport, was ready to resume testing after setting 8-in. casing through the collapsed 10-in. surface string. The pipe collapsed during a drill-stem test at 5,390-5,421 ft. Total depth is 5,930 ft. Kingwood Oil Co. 1 R. O. Garrett is a new Wise County operation, 4 miles northwest of Chico in the southwest section of the C. W. Eggery Survey, Abstract 268. It spudded in this week and will go to 5,500 ft.

In Archer County, R. C. Lipscomb 1 L. A. Snider, 2 miles southeast of the new Jones area, in Section 2,601, TE&L Survey, reported a kick on electrical survey run to 4,750 ft., and was running pipe before making production tests. A new 7,000-ft. test, 1½ miles north of Mallard field, and about the same distance northwest of Mallard townsite, has been scheduled by Akin & Dimock as the 1 Abercrombie, 2,196 ft. from east and 2,300 ft. from north lines of Section 152, J. W. Harris Subdivision.

NORTH CENTRAL TEXAS (DISTRICTS 7-B & 9) SUCCESSFUL WILDCAT

Archer County: Reno Oil Co. 1 L. F. Wilson, Blk. 9, ATNCL Sur., 5 mi. S Holliday, pumped 42 bbl. 42°-gravity oil a day, sand 3,916-50 ft., TD.

NORTH CENTRAL TEXAS (DISTRICTS 7-B & 9) WILDCAT FAILURES

Archer County: Fain & McGaha et al 1-A L. F. Wilson, Blk. 85, ATNCL Sur., 9 mi. N Archer City, dry, TD 4,144 ft. in shale, sand with show of oil 1,570-81 ft.

Baylor County: C. W. & Wm. L. Snoddy 1 C. C. Sanders, Wm. Ahlert Sur., A-3, 7 mi. SW Rendham, dry, TD 1,819 ft., top limestone 1,767 ft.

Callahan County: A. R. McEheath & Fred Snuggs 1 S. C. Hennesey, Sec. 1, BS&F Sur., 5 mi. N Clyde, dry, TD 1,988 ft., no shows.

Jones County: Joe Josephson 1 J. G. Green, J. Bliss Sur., 9 mi. SW Anson, dry, TD 3,357 ft., Swastika sand 3,283 ft., limestone with odor 3,089 ft., sand with show of oil 3,283 ft.

Montague County: D. S. Johnson 1 W. B. Rich, J. W. Whitehurst Sur., 2 mi. NW Belcherville, dry, TD 6,055 ft., Caddo 5,513 ft., Ellenburger 5,884 ft.

Taylor County: S. C. Herring 1 Henry Sayles, Lot 11, Blk. 122, W. R. Willis Sur., 5 mi. SW Tye, dry, TD 3,266 ft. in limestone.

Placid Oil Co. 1 G. D. Hamilton, Sec. 2, H. Hand Sur., 4 mi. NW Tye, dry, TD 2,861 ft., sand 2,343 ft., Flippen 2,370 ft., no shows.

Throckmorton County: Bridwell Oil Co. 1 R. P. Lee, Sec. 192, BBB&C Sur., 6 mi. SW Throckmorton, dry, TD 5,466 ft., Caddo 4,696 ft., Mississippi 5,192 ft., Ellenburger 5,461 ft.

Wichita County: Cochran & Crain 1 Wag-

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goner estate, Sec. 35, Blk. 5, H&TC Sur., 8 mi. S Electra, dry, TD 2,204 ft., oil shows 1,597 and 1,920 ft.

Alexander Goldsmith 1 R. L. Kempner, location not reported, dry, TD 4,633 ft., Ellenburger 4,600 ft.

Wilbarger County: Warren Oil Corp. 1 D. A. Melton, Sec. 15, Blk. 5, H&TC Sur., 9 mi. SE Harrold, dry, TD 2,236 ft.

CALIFORNIA

General Petroleum Extends Cat Canyon Field

LOS ANGELES.—General Petroleum Corp. has added several acres to Cat Canyon field of Santa Barbara County with completion of the 46-22 Los Flores, 22-9n-33w, as an oil producer. With 7-in. casing set at 5,615 ft. and 3-in. tubing hung at 6,039 ft., the well was brought in on pump for 160 bbl. daily from a total depth of 6,146 ft. The 46-22 Los Flores is located approximately ¼ mile west of Douglas Oil Co. production in Cat Canyon field and approximately ½ mile northwest of Standard Oil Co. of California production. On the basis of results achieved at this well, General Petroleum has staked location for the 36-22 Los Flores in 22-9n-33w, and is expected to spud in this test shortly.

Trico Oil & Gas Co. reportedly has cored 21 ft. of oil sand in its 2 Petaluma Community 5, 30-5n-6w, Sonoma County. Company officials have stated that they believe the sand, encountered at 950 ft., is capable of producing crude at the rate of 50 bbl. daily. Drilling, however, is progressing below the 1,275-ft. mark at the present time. The 2 Petaluma 5 is located in an area where two wells drilled several years ago encountered good oil showings but were never completed as commercial oil wells.

Richfield Oil Corp. 17-1 Boyle Community, 35-1s-13w, a test well located at Sixth and Mott streets in the Boyle Heights district of Los Angeles, has been cored to a depth of 3,763 ft. and currently is being reamed to permit coring ahead. The venture has been attracting considerable interest during the past week due to the fact that frequent streaks of oil sand interbedded with shale have been encountered below 3,580 ft. Company officials describe the showings as encouraging but of doubtful production value. Primarily interest in this test stems from the fact that approximately 6,000 townlot owners participate in the community lease and that the test is located in an industrial section of the city of Los Angeles where exacting drilling ordinances are an important factor in influencing exploratory work. Richfield and Boyle Realty Co. jointly hold 30 community leases of approximately 40 acres each in this area.

New locations remained at a high level during the past week as California operators announced locations for 56 new wells. This, however, was a decrease of 16 from the record number staked during the previous week. Kern River received the greatest concentration of new locations with 10 of the proposed ventures, while Wilmington and Huntington Beach followed with 4 each.

CALIFORNIA SUCCESSFUL WILDCATS

Fresno County, Raisin City area: Real Oil Co. 1 San Joaquin, 11-15s-17e, pumped 100 bbl. per day, gravity 26.0°, water cut 2 per cent, elev. 192 ft., TD 6,430 ft., sanded up, preparing to clean out.

Kern County, Grapevine-Tejon area: Drilling & Exploration Co. 76-32 J. V., 32-11n-19w, pumped 105 bbl. daily, gravity 16.1°, water cut 4 per cent, 2½-in. tubing 2,603 ft., elev. 1,075 ft., TD 2,615 ft.

McDonald Anticline area: San Joaquin Exploration Co. 7 Layman, 12-28s-19e, pumped 25 bbl. daily, gravity 16.0°, water cut 0.1 per cent, elev. 989 ft., TD 822 ft.

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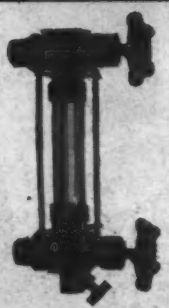

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Monterey County, San Ardo area: The Texas Co. 3 Rosenberg, 34-22s-10e, pumped 34 bbl. daily, gravity 10.0°, water cut 8 per cent, elev. 481 ft., TD 2,478 ft.

Ventura County, Ojai area: Richfield Oil Corp. 53 Ojai, 13-4n-22w, pumped 76 bbl. daily, gravity 24.0°, water cut 20 per cent, elev. 1,747 ft., TD 4,461 ft.

CALIFORNIA WILDCAT FAILURES

Kern County, Comanche Point area: Gene Reid Exploration Co. 8 fee, 32-12n-18w, dry, elev. unknown, TD 620 ft.

Sharktooth area: Barnsdall Oil Co. 7 Alma, 15-28s-28e, dry in gray sand, elev. 1,027 ft., top Vedder 2,717 ft., TD 2,773 ft.

Los Angeles County, East Los Angeles area: General Petroleum Corp. 1 Industrial, 8-2s-12w, dry, elev. unknown, TD 9,285 ft.

San Luis Obispo County, Cuyama Valley area: Navy Oil Co. 1 Kirschenmann, 12-10n-27w, dry in gray sand, elev. 2,000 ft., drill pipe stuck, recovered to 3,900 ft., TD 5,127 ft.

CANADIAN FIELDS

Leduc Field Output Gains 1,650 Bbl. Daily

CHATHAM.—Since March 1, a total of 12 new wells have been completed in the Leduc field, with combined open flow potential of 24,067 bbl. daily, or an average of 2,005 bbl. per well. Nine are D-3 producers with combined potential of 22,411 bbl., and three are D-2 wells with combined open flow of 1,656 bbl. Since actual production is sharply restricted, with D-2 wells limited to 100 bbl. and D-3 to 150 bbl., the 12 producers will add about 1,650 bbl. daily to the field output. A feature of new development is the pioneering by Imperial Oil of a 1½-mile wide strip west of the main field and east of the western outpost producers. Imperial 60, LSD 11, 20-50-26w4, ¾ mile west of Home Leduc 5 producer, is the latest of these new tests. The most important new producer is Imperial-Woodbend 1, LSD 5, 15-51-26w4, 3½ miles northwest of the main field. Plugged back to 5,323 ft. after getting water level at 5,340 ft., it is making 143 bbl. through 9/64-in. choke. Three other wells are drilling in the Woodbend area.

Flush production is reported large in wells now being completed. Imperial 32, LSD 16, 22-50-26w4, finishing at 5,333 ft., is being put on restricted production after flush of more than 2,000 bbl. a day. Imperial 42, LSD 4, 36-50-26w4, finished at 5,304 ft., had flush of 3,240 bbl. Imperial 47, LSD 7, 21-50-26w4, just finished at 5,355 ft., started around 2,500 bbl. All three are producing from D-3 zone.

Imperial 9, LSD 16, 3-50-26w4, finished at 5,466 ft., and extending the field to the southeast, made 660 bbl. in 11 hours and has been restricted to 144 bbl. a day through 10/64-in. choke.

Home Oil is starting work on three new locations, two toward the south end of the field. Globe-Leduc 7, LSD 5, 19-50-26w4, which extended the field to the west, has set casing at 5,339 ft. and is being placed in steady production. The well, which got production in both zones, is the most westerly D-3 producer and will be completed in that horizon, a second D-2 well being drilled.

Extending the field 1¾ miles southeast, Okalta-Leduc 2, LSD 10, 33-49-26w4, got 150,000 cu. ft. gas and 270-ft. rise of clean oil in the D-2 zone at 5,275 ft., after an earlier test which brought an oil rise in 55 minutes. The well is drilling below 5,440 ft. and past the expected water line to test the D-3 zone. It is thought that this well may be encountering conditions different from the main field, in that the green shale normally encountered between the two producing zones may be pinching out and the D-2 and D-3 horizons may merge farther south. Location is 1½ miles south of a group of wells that logged tight in the D-2.

Barrhead.—In the Barrhead district, northwest of Edmonton, Canadian Gulf-Alice O'Brien 1, LSD 4, 12-59-3w5, has been abandoned at 5,655 ft. after tests in the Devonian limestone failed to indicate production possibilities.

Pincher Creek.—In the southern Alberta foothills, Canadian Gulf-Pincher Creek 1, LSD 15, 24-3-29w4, with large wet gas production and 325 bbl. potential recovery of 51°-gravity oil from the upper Madison at 11,927 ft., is clearing the hole of packer fragments preparatory to deepening to the lower horizon of the Madison limestone. Canadian Gulf-Walter Marr 1, LSD 1, 28-4-29w4, is rigging.

West Taber.—In the West Taber field, southern Alberta, California-Standard has finished Taber Province 74-15A, LSD 5, 15-9-17w4, at 3,234 ft. with pumping production around 60 bbl. a day. Taber-Province 72-15A, NW 4, 15-9-17w4, has spudded.

Stimson Creek.—In the Stimson Creek area of the Alberta foothills, south and west of Turner Valley, Socony-Vacuum 1, LSD 12, 5-15-2w5, first test by the company in Alberta has been abandoned at 5,431 ft. The test got the Madison limestone high without production but after entering the underlying Banff shales faulted back to the Blairmore formation.

Owen Sound.—In the Owen sound district of Ontario, near the border line between Bruce and Grey counties, Annan Petroleums of Toronto is drilling on the Duncan Morrison farm at East Linton. The test contacted the Trenton limestone high at 1,200 ft. and is deepening. The Trenton, which produced some gas farther west at Hepworth in Bruce County, is the potential production horizon.

Lloydminster.—In the Lloydminster field, eastern Alberta, Superior 10, LSD 10, 14-50-2w4, finished at 1,962 ft., is pumping 40 bbl. daily. Granleduc 2, LSD 7, 14-50-2w4, at 1,975 ft., and Holly 3, LSD 8, 22-

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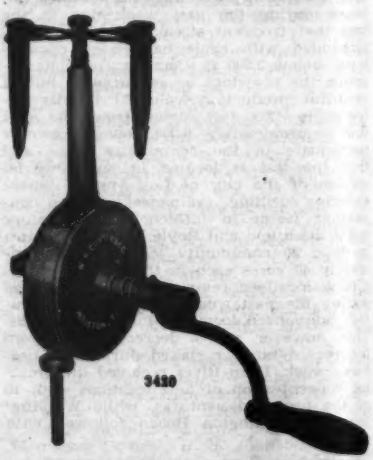

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50-2w4, at 1,993 ft., have been placed on the pump with the latter making around 100 bbl. Command-Lloyd 1, northwest of Lloydminster, swabbing at 1,930 ft., blew in with about 6,000,000 cu. ft. of gas and caught fire, destroying the rig. Four dynamite shots were required to extinguish the blaze.

Gaspe.—In the Gaspe Peninsula of Quebec, Imperial-Gaspe 1 is below 3,457 ft. and nearing the potentially productive coral reef horizon at the base of the Silurian formation. A new drilling crew is en route from Oklahoma to complete C.P.L. 1, on the Galt Brook dome, standing at 2,728 ft. Before deepening, two zones will be tested, one at 2,137 ft. which has gas showings near the bottom of the well which has shown some high gravity paraffin base crude. Venture 2, bottoming at 2,132 ft., is fishing for tools.

EASTERN TEXAS

Limestone County Wildcat To Test Oil Show

DALLAS.—In Limestone County, R. J. R. Oil Corp. 1 Jones heirs, R. Flippen Survey, 1½ miles north and slightly west of Kosse, had total depth at 3,594 ft. and prepared to set casing before testing an oil show. Electric log tops released were: Austin chalk 2,837-3,111 ft., and top of the Buda 3,515 ft. Operators thought it was still in the Buda at total depth.

A new deep test for Anderson County, 5 miles southwest of the Blackfoot field, was announced this week. Location was held up pending clearing of title, but it was understood to be in the B. Proctor Survey. Sanders & Murchison will drill the well, while Gulf Oil Corp. and Humble Oil & Refining Co. are said to be supporting the venture.

The LaGloria Corp. has moved in materials for a second test of its block on the west flank of the Waskom area of Harrison County. It will be the 2 Smith & Lindsey, and is on the west side of a 150-acre tract in the Simpson Holloway Survey. Location is west of the same company's 1 Smith & Lindsay, which established production in the area from the Hill zone of the Glen Rose.

In the Patroon area of Shelby County, Humble Oil & Refining Co. 1-C Pickering was coring at 8,322 ft. A core just above that level recovered dark gray dolomitic limestone, with no shows.

W. F. Nenney's 1 Ione Braziel, Paluxy test in Smith County, was drilling below 6,947 ft. in limestone. R. J. Caraway 1 Aaron Sessions, Jose Maria Musquez Survey, 9 miles east of Rusk, a new Cherokee County test, was drilling at 3,440 ft. in chalk. Humble Oil & Refining Co. R. P. McWatters, Freestone County, has progressed below 11,885 ft. in sand with streaks of shale. Humble's 1 Whatley was running electric survey at 7,318 ft., total depth. T. H. Humphries 1 E. B. Tuggle, Paluxy test in the Ed Fitzgerald Survey, 4 miles east of Kemp, Kaufman County, was drilling at 3,800 ft. in sand and shale. It logged the Woodbine at 3,440 ft., sub-Clarksville at 3,025 ft., Red Beds at 3,585 ft., and the Dexter sand at 3,706 ft.

Hiawatha Oil & Gas Co. 1 Will E. Johnson, southwest outpost to the San Augustine field, San Augustine County, was drilling below 6,766 ft. in shale and limestone. No further shows have been reported below 6,018-6,103 ft., where a drill-stem test recovered 55 ft. of mud and oil.

EAST TEXAS (DISTRICTS 5 & 6) WILDCAT FAILURES

Limestone County: Stanolind Oil & Gas Co. 1 J. E. McElroy, G. W. McGrew Sur., 1½ mi. SE Coolidge, dry, TD 498 ft., started as Woodbine test, ran low and abandoned.

Marion County: W. C. Curry 1 Susie A. Chatten, Jackson Grayson Sur., 7 mi. NE Jefferson, dry, TD 3,800 ft., no shows.

Navarro County: J. Z. Werby and S. Y. Dorfman 1 F. D. Wright estate, J. Albrackett Sur., dry, TD 3,450 ft., Midway 320-365 ft., Nacatoch 840 ft., Austin 2,620-2,875 ft., Woodbine 3,318 ft., elev. 411 ft.

MICHIGAN

Michigan Fields Record Seven Producers

SAGINAW.—Seven of the 12 completions for the week in Michigan oil fields were producing wells, the best flowing 225 bbl. in 18 hours after acidizing. That well is Sun Oil Co. 1 Garfield in Section 12, Garfield Township, Kalakaska County. Production came from 4,400 ft., the hole being plugged back from 4,486 ft. Eleven new locations in seven counties were announced.

Four of the five dry holes were wildcats. Two Bay County completions produced 65 and 50 bbl. daily after acidizing. Smaller producers were completed in Allegan, Newaygo, and Tuscola counties. In Tuscola's Arbela field a second completion was dry.

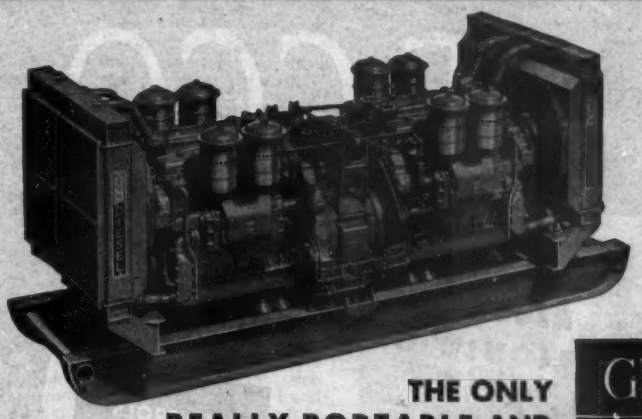
In each of the following counties two new locations were started: Allegan, Muskegon, Montcalm, and Midland; one each in Oceana, Barry, and Kent.

MICHIGAN WILDCAT FAILURES

Allegan County, Monterey Township: Del Fortney 1 Rose Jones, SE SE NW 4-3n-13w, dry in Traverse limestone, TD 1,661 ft.

Isabella County, Fremont Township: Union Development Co. 1 Wallace W. Corser, SE SE SW 1-13n-5w, dry in Dundee, TD 3,722 ft.

Montcalm County, Bloomer Township: Mercer Oil Co. and C. L. Maguire, Inc., 1



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Ney Carey, NW SE SW 7-9n-5w, dry in Dundee, TD 3,144 ft.

Ottawa County, Spring Lake Township: Ford Oil Co. 1 John G. and Marinus Wierenga, NE SW NW 12-8n-16w, dry in Alepna, TD 1,728 ft.

ROCKY MOUNTAIN

Powder River Basin An Active Area

DENVER.—The Powder River basin of northeastern Wyoming and southeastern Montana during the coming summer will be one of the most active oil-exploration areas in the Rocky Mountain region, both from a geophysical research and wildcat drilling standpoint. One of the most interesting tests to be drilled will be Continental Oil Co.'s Taylor-Sussex wildcat, located 15 miles north of Salt Creek field. The well is 1 Unit, NW NW SE 17-42n-78w, Johnson County, and the operator is now spudding. Location for this wildcat is based on geophysical work, together with surface geology, and the test will go to Sundance at around 8,000 ft., and possibly to Tensleep below 10,000 ft. This location is on the west side of the Powder River basin, and several large acreage blocks have been assembled in this area for drilling this year. Amerada Petroleum Corp.'s Sussex block immediately north of Taylor-Sussex is reportedly now being unitized and will be drilled soon, and Tide Water Associated Oil Co.'s Teasdale block, southwest of Taylor-Sussex, is also reported ready for drilling.

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Leasing of these blocks was completed more than a year ago and geology detailed prior to recent leasing campaigns resulting from development drilling in the Mush Creek area, on the east side of the basin, and the discovery at Adon in the center of the basin by The Texas Co. a few months ago. As a result of the Adon and Mush Creek activities it is estimated that more than 2 million acres of lands have been leased and optioned by operators for geophysical and geological investigation during the coming summer.

Along the east flank of the basin, in the so-called "Mush Creek trend," several new drilling operations are expected within the next few weeks. One of these is The Texas Co. Wakeman Flats wildcat at 1 Robinson, NW NW NE 9-49n-67w, southwestern Crook County, which will be drilled to Newcastle or 4,500 ft. Results of this and other tests may to a great extent determine future drilling activity in the area between the North Ant Hills sector in Niobrara County and the Montana State line. Most active operators in the area are The Texas Co., Continental Oil Co., Carter Oil Co., Superior Oil Co., Texas-Pacific Coal & Oil Co., Phillips Petroleum Co., Sohio Oil Co., and British American Oil Producing Co., and many independent operators.

Pure Oil Co. is now drilling in shale below 14,130 ft. at the important West Poison Spider wildcat in Natrona County, Wyoming. The well is now the deepest test ever drilled in the Rocky Mountain region, and it is rumored the operator may drill below 15,000 ft. No formation tops have been released on the wildcat but it is believed the well is in the upper Frontier formation. Shows of oil and gas were encountered at 13,800 ft. and 7-in. casing was run to 13,791 ft. but the zone was not tested. This well is located on a seismic high in the eastern side of Wind River basin, southwest of the town of Casper.

In southeastern Colorado J. M. Huber Corp. and Frontier Refining Co. have skidded the rig to a new location after abandoning 1 McCarroll, SW SW NE 11-28s-50w, Baca County. Lost circulation at 1,922 ft. was the cause of the abandonment and the operator spent 3 weeks in an effort to regain circulation. Location for the new test will be at NW NW NE 11-28s-50w, ⅜ mile north of the abandoned hole. These wells are on the north side of the Freezout Creek block held by the companies, and the operators have previously drilled four dry holes on the block. The wells are drilled in an effort to find oil accumulation in stratigraphic trap of beds against the eastern flank of the Las Animas arch.

Continental Oil Co. is retesting its discovery well at South Shoshone, Park County, Wyoming, and the well is making only 25 bbl. of fluid daily, cutting 22 per cent water. The well is 1 Unit, SW NE NW 25-50n-105w, and was drilled to 2,842 ft., total depth, in the Madison, last winter prior to plugging back for a test of the Embar zone between 3,705-60 ft. The well was shut in after pumping tests indicated a small discovery. Prior to the initial tests the well was acidized with 1,000 and 2,500 gal. and it is now probable that this section will be reacidized and testing continued.

New operations.—Seventeen new locations were made in the Rockies during the week, with seven in Wyoming, five in Colorado, and five in Montana. Two central Montana wildcats are scheduled, increasing the drilling activity to the Big Snowy group in that area. The Texas Co. has made location for 1 Northern Pacific Railroad, SE NE NW 19-10n-27e, at Big Wall dome, Musselshell County, 22 miles southwest of Ragged Point. Sixty miles southwest of Ragged Point, R. M. Amick of Billings has made location for 1 Northern Pacific Railroad, SE SE NE 29-8n-21e, at Woman's Pocket Anticline, Golden Valley County, for a deep test. Both of these wells are of particular interest because of the discovery of oil by The Texas Co. in the Kibbey (Big Snowy group) sand at around 4,500 ft. at Ragged Point. Neither Big Wall

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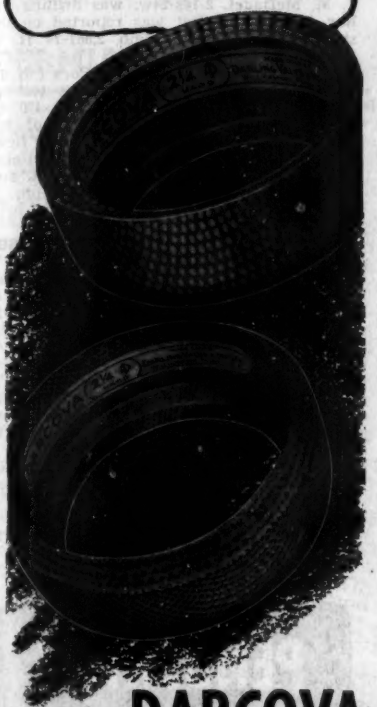

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nor Woman's Pocket have been drilled to the Kibbey sand.

Included in the Wyoming new operations is an extension in the North Ant Hills area by Wood River Oil & Refining Co. This is Wood River's first Rocky Mountain operation since taking over properties of Snowden & Schneider in the Ant Hills area. The well will be drilled to Newcastle, productive in two wells in the North Ant Hills area, and may go to Dakota, where it is reported Ames Management recently had shows of oil in a well ½ mile from the new location. Wood River's new well will be 1-B J. Wasserberger, SW NW SE 1-37n-63w. Other locations during the week were for pool wells.

Completions.—There were 12 completions during the week, with 6 in Wyoming, 4 in Montana, and 1 each in Colorado and northern New Mexico. A near abandonment in Utah is Mountain Fuel Supply Co.'s wildcat on the Last Chance structure in Emery County. This well, one of the most expensive ever drilled in Utah, went to 8,518 ft., total depth, and Mountain Fuel has been testing the well for the past 3 weeks. American Liberty Oil Co. is a partner with Mountain Fuel in the operation. No formation tops and tests have been released by the operator. Regular completions for the week were routine pool wells.

KANSAS

Former Dry Hole is Pool Opener

MUCH recent evidence seems to indicate that there is a general movement, leading to a more careful study and rechecking of data on some wells that have been completed as dry holes in the past. One of the more recent results of this trend is a well that appears to be a pool opener for McPherson County. Westgate-Greenland Oil Co. and R. S. Webb 1 Ruth, NE NE SW 13-18s-1w, is reported to have had 1,300 ft. of oil and 100 ft. of water in the hole over night. The well was first drilled by Republic Natural Gas Co. in 1945 and abandoned without running casing. A study of the data on the hole resulted in the decision to clean out for a test. Total depth is 2,830 ft. with the Mississippian topped at 2,805 ft.

About 2 miles west of the El Dorado pool in Butler County, Rex & Morris and E. H. Adair have a Viola lime prospect at 2 Rice, SE SE NE 5-26s-4e. Hole is reported to have filled with oil from a depth of 2,566 ft. Casing has been set at 2,560 ft.

In Rice County, Holl, Branine, and T. H. Allen 1 Turner, SE SE SE 6-21s-6w, southeastern Rice County, swabbed 2½ bbl. of oil per hour for 8 hours from the Mississippian at 3,498-3,507 ft. Casing was set on the conglomerate at 3,484 ft. Well is about 1 mile west of the Welch pool.

Cities Service Oil Co. has staked a rank wildcat for a test of the Arbuckle in Rush County at 1 Kleinsteiber, NW NW SE 29-19s-18w, about 12 miles northwest of the Rutherford pool. Carter Oil Co. is a partner in the test.

Barnsdall Oil Co. seems to have a good prospective oil well at 2 Krankenberg, SE SE SW 14-22s-12w, Stafford County, about 1 mile east of the discovery well in the West Heyden pool and ½ mile west of the Heyden pool. Casing was set on the Arbuckle at 3,666 ft. with total depth of 3,670 ft. After acid treatment well was swabbed for 35 bbl. per hour from 1,400 ft. off bottom.

New locations recorded for the week totaled 67. Barton County led with 13. Russell County had six and Rice County furnished five.

KANSAS WILDCAT FAILURES

Butler County: Shell Oil Co. 1 Brown, SW SW SE 24-25s-6e, dry, TD 2,784 ft., no tops reported.

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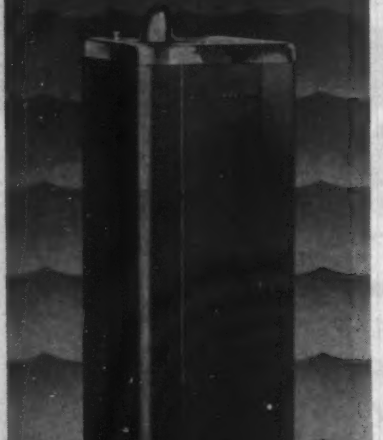

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Ellis County: Vernon and Bennett & Roberts 1 Smith, SW SW SW 23-12s-16w, dry, TD 3,463 ft., Topeka 2,872 ft., Heebner 3,117 ft., Dodge 3,150 ft., Lansing 3,171 ft., Arbuckle 3,445 ft.

Kingman County: Bridgeport Oil 1 Sutton "B," SW SW NW 16-27s-8w, dry, TD 4,541 ft., Kansas City 3,397 ft., Mississippian 4,015 ft. with show of free oil at 4,027-36 ft., Base Mississippian 4,089 ft., Viola 4,318 ft., Simpson 4,386 ft., Arbuckle 4,489 ft.

Harbar, Huber & Patton et al 1 Miller, C NE 35-28s-7w, dry, TD 4,568 ft., Base Oread 3,061 ft., Douglas sand 3,120 ft., Lansing 3,272 ft., Mississippian 4,035 ft., Base Mississippian 4,323 ft., Viola 4,435 ft., Simpson 4,447 ft., Arbuckle 4,546 ft.

McPherson County: Barbara Oil 1 Tecter, SW SW NW 12-17s-1w, dry, TD 2,876 ft., Lansing 2,206 ft., Mississippian 2,829 ft.

Rooks County: Doley Oil 1 Zeigler, NW NW NW 21-10s-16w, dry, TD 3,780 ft., anhydrite 1,288 ft., Topeka 2,980 ft., Lansing 3,257 ft., conglomerate 3,575 ft., Arbuckle 3,737 ft.

Russell County: Brack Oil, Inc., 1 Wenger, C S/ SW SW 29-12s-13w, dry, TD 3,257 ft., anhydrite 575 ft., Topeka 2,475 ft., Heebner 2,695 ft., Dodge 2,714 ft., Lansing-Kansas City 2,750 ft., conglomerate 3,096 ft., Viola 3,111 ft., Simpson 3,712 ft., Arbuckle 3,257 ft.

LA.-ARK.

Bossier Parish Test Runs Electric Log

SHREVEPORT.—M. T. Halbouty and Stanolind Oil & Gas Co. 1 Bolinger-Boyd, Bossier Parish wildcat east of the Plain Dealing field in 30-23n-12w, had total depth at 6,392 ft., and was running electrical survey. Top of the Pettit porosity was logged at 6,302 ft., and cores from 6,303-20 ft. recovered oolitic limestone with a trace of free oil, gas odor on a fresh break, and a bottom 6 in. of limy shale. A 55-minute drill-stem test was run on that interval, using ¼-in. chokes, which produced a slight blow but no working pressure, and recovered 10 ft. of mud with only a rainbow show of oil. A 9-ft. core section between 6,342-62 ft. was oolitic lime with a trace of oil.

Carter Oil Co.'s 1 Martin Matthews, deep test northwest of the Simsboro field, in 22-18n-4w, Lincoln Parish, logged top of the Cotton Valley at 9,050 ft., on an elevation of 353 ft. Operators reported a drilling break at 9,699-9,703 ft. but did not drill-stem test. A core from 9,703-06 ft. recovered 3 ft. of hard, slightly porous gray sand, with spotted stain and fluorescence and fair gas ordor on fresh break. Coring continued below 9,706 ft.

In Natchitoches Parish, Continental Oil Co. 1 Pardee Co., 30-12n-6w, was drilling below 10,187 ft. in Travis Peak. It had a drilling break at 9,902-06 ft., then cored from 9,906-16 ft., recovering 5 ft. of gray-brown hard, fine, nonporous mica sand with streaks of dark, hard shale. Electric log was run to 10,131 ft.

C. M. Bagley et al 1 T. W. Auger, 36-23n-1w, Union Parish, Nacatoch sand test that has reported finding some oil, perforated between 2,195-98 ft. with 24 shots and was pumping salt water with 2 per cent oil. In the same parish, Pan-American Producing Co. 1 J. H. Albritton, 10-19n-1e, was drilling below 7,171 ft. in Travis Peak.

The Texas Co. 1 F. J. Rambin, DeSoto Parish, 23-11n-11w, had total depth at 8,080 ft. in Travis Peak. It had a drilling break at 7,923-26 ft., and cored from 7,926-36 ft. and recovered gray, limy shale with no shows. Electric log was run to 8,000 ft., and casing was to be set to 5,000 ft.

Kerr-McGee et al 1 Frost Lumber, 14-11n-15w, DeSoto Parish, drill-stem tested between 4,991-98 ft., recovering 105 ft. of salt water and mud, with a show of oil. Drilling continued below 5,655 ft. Sample tops placed base of the Massive anhydrite at 4,965 ft., and top of the James limestone at 5,480 ft.

Calhoun & LaFitte Drilling Co. 1 Boone, semi-wildcat north of the Grogan field, in 25-11n-11w, DeSoto Parish, had total depth at 2,975 ft. Electric log was run and operators were to drill-stem test. An oil show around 2,800 ft. had not been confirmed.

In Arkansas, Joseph P. Bell 1 Ida J. Cone, new 5,000-ft. test in 23-16s-5w, Ashley County, was drilling in an unidentified formation at 3,310 ft. Taylor & Kirby 1 Moore estate, new 4,000-ft. test 20 miles north of Warren in 29-9s-9w, Cleveland County, set surface casing and was drilling ahead. In Lafayette County, McAlester Fuel Co. 1 J. M. McDanel, 2-16s-24w, was drilling below 4,346 ft. No test was reported on the show of oil found around 2,861-74 ft. in sand.

In Miller County, Carter Oil Co.'s 1 H. H. Gildon, new 9,000-ft. Smackover test in 22-16s-27w, set surface casing to 470 ft. Location is 3½ miles northwest of the Fouke field. East of the El Dorado field, R. M. Crabtree 1 Broyles, 2-18s-15w, Union County, ran electrical log to 1,988 ft. and was waiting on orders. Total depth is 2,250 ft.

NORTH LOUISIANA WILDCAT FAILURES

Claiborne Parish: Maritzky & Bibby 1 W. C. Richardson, NW NW NW 23-22n-6w, dry, TD 3,119 ft., Wilcox 1,015 ft., Arkadelphia 2,060 ft., Nacatoch 2,210 ft., base annona 2,681 ft., Blossom 2,908 ft., elev. 279 ft.

Union Parish: Shell Oil Co., Inc., 1 Frost Lumber Co., SE SE 15-22n-1e, dry, TD 8,833 ft., Lower Cretaceous 2,940 ft., James 3,097 ft., Pettit 3,483 ft., Travis Peak 3,580 ft., Cotton Valley 5,618 ft., Smackover 8,668 ft., elev. 227 ft.

Earl C. Ward 1 G. H. Vaughn, NE NE NE 16-21n-1w, dry, TD 2,254 ft., Nacatoch 2,100 ft.

Winn Parish: Burden-Kemp & Hunter 2 Tremont, NW SE 24-12n-2w, dry, TD 1,834 ft.

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Burden-Kemp & Hunter 3 Tremont, NE NE 15-12n-2w, dry, TD 1,825 ft., Wilcox 1,158 ft.

ARKANSAS WILDCAT FAILURES

Little River County: Lee & Burnett 1-A Troth, NW NW SE 4-14s-28w, dry, TD 4,000 ft.

Saline County: Don M. Fitzwater 1 Malvern Lumber, NE SE SE 13-3s-16w, dry, TD 660 ft.

St. Francis County: Petroleum Producing Corp. 1 Engler Bros., SE SE SE 17-4n-1w, dry, TD 2,727 ft., Wilcox 1,160 ft., Midway 1,528 ft., elev. 214 ft.

Harvey J. Weir & Sons 1 E. P. Lynn, SE SE SE 7-4n-1e, dry, TD 2,788 ft.

PERMIAN BASIN

Four Offset Tests Staked in Hale County

MIDLAND.—General American Oil Co. staked four offset tests to its new Pennsylvanian limestone discovery 2 miles northeast of Petersburg in southeastern Hale County. Only one of the locations is in Hale County, while the others are in southwestern Floyd County. The company's 2 Byrd is to be a ½-mile west offset, and is 660 ft. from south and 1,650 ft. from wes tlines of the 300-acre Byrd tract. In Floyd County, the 1 E. M. Carmichael is ¾ mile east of the discovery, 660 ft. from south and 1,980 ft. from east lines of the Carmichael lease, in Section 18. The 1 Bob Mayo is ⅝ mile southeast of the discovery, and is 660 ft. from south and west lines of Section 18. The fourth outpost is 1 Flora C. Strickler, 1½ miles to the northeast, and 660 ft. from north and east lines of Section 19, Block K, TT Survey. This well is scheduled to around 8,200 ft., while the first three will go to 6,000 ft.

General American's discovery, 1 A. F. Byrd, Section 17, Block K, TT Survey, was rigging up pump for completion attempt. Pay zone is the Cisco limestone from 5,830-95 ft.

In Crockett County, tentative top on the Ellenburger has been placed at 11,470 ft. in The Texas Co. 1 Pierce, Section 5, Block O, C. W. Brown Survey, 21½ miles southeast of Ozona. Operators of the well did not confirm this top. Drill-stem tests, one at 11,470-92 ft. and another at 11,475-11,515 ft., failed due to mechanical difficulties. Total depth was 11,515 ft. on last report.

Phillips Petroleum Co. 1 M. J. Weddell, Schleicher County wildcat 11 miles southeast of Christoval, was drilling deeper after recovering 900 ft. of mud and 2,900 ft. of salt water on a 1-hour drill-stem test between 6,174-6,214 ft. Last week the well had promising shows of oil and gas at 5,870-80 ft.

In southeast Upton County, Samedan Oil Co. 1 A. D. Neal, 1½ miles northeast of Rankin, had favorable shows of oil in the Grayburg limestone and operators thought it might make a shallow producer if production is not found around 6,700 ft., contract depth. On an elevation of 2,602 ft., it topped the Grayburg at 3,795 ft., and the first test between 3,816-60 ft. recovered 30 ft. of gas-cut drilling mud. Deepened to 3,895 ft., a 45-minute test, with packer at 3,848 ft., recovered 20 ft. of drilling mud with no shows. Operators cored from 3,895-3,915 ft., recovering 10 ft. of sandy lime, of which the top 6 ft. had bleeding oil and water, and the bottom 3½ ft. had bleeding oil with only a trace of water.

According to reports, top of the Grayburg at 3,795 ft. is high, geologically, to other tests in the region. Cores from the two sections tested were said to have had good shows of oil but the formation was tight and might require both shooting with nitro and acid treatment to obtain commercial production.

Anderson Prichard Oil Corp. and Vickers Petroleum Co. 1 Miss Martin Francis Foster, southeastern Sterling County Permian discovery, was moving off rotary rig for completion with cable tools.

WEST TEXAS (DISTRICTS 8 & 7-C) SUCCESSFUL WILDCATS

Andrews County: Phillips Pet. Co. 5-M University, Sec. 31, Blk. 13, University Lands Sur., 1¾ mi. SW Ellenburger production in Fullerton area, top Ellenburger 10,355 ft., perf. 10,590-640 ft., flowed 740 bbl. 44°-gravity oil a day, ¼-in. choke, TP 1,050 psi., GOR 475 cu. ft., natural well, TD 10,828 ft., elev. 3,269 ft.

Crockett County: Continental Oil Co. 1 University A-13, Sec. 13, Blk. 47, University Lands, 6 mi. S Barnhart field, pumped 104 bbl. 45°-gravity oil a day, Silurian top 9,220 ft., perf. 9,210-9,300 ft., TD 10,232 ft., PB 9,408 ft., elev. 2,699 ft.

WEST TEXAS (DISTRICTS 8 & 7-C) WILDCAT FAILURES

Andrews County: The Texas Co. 1-A J. E. Mabee, Acct. 3, Sec. 34, Blk. 39, T&P Sur., 5 mi. N Mabee field, dry, TD 4,855 ft., Grayburg 4,440 ft., San Andres 4,710 ft., elev. 2,959 ft.

Castro County: Sun Oil Co. 1 Mrs. Herring, Sec. 46, Blk. T-4, T. A. Thompson Sur., 5 mi. S Dimmitt, dry, TD 10,500 ft., anhydrite 1,570 ft., San Angelo 3,720 ft., Tubb 4,740 ft., base Pennsylvanian and top Mississippi 9,090 ft., Ellenburger 9,340 ft., elev. 3,811 ft.

Pecos County: Chas. H. Houston 1 Cordova Union Oil Co., Sec. 8, Blk. 141, T&St.L. Sur., 17 mi. NE Fort Stockton, dry, TD 1,478 ft., sulfur water 1,475 ft.

Runnels County: Wm. Gruber and Emil Ott 1-A Mrs. B. J. Niehaus, Sec. 511, BBB&C Sur., 5 mi. S Ballinger, dry, TD

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TEXAS PANHANDLE (DISTRICT 10) WILDCAT FAILURE

Roberts County: Phillips Petroleum Co. 1 Jenkie, Sec. 38, Blk. 2, I&GN Sur., 12 mi. SW Miami on county line, dry, TD 11,730 ft., tops not yet released.

SOUTHEASTERN NEW MEXICO

HOBBS.—Barnsdall Oil Co. 9 Cooper, exploratory test in the shallow Monument field, Lea County, in 12-20s-36e, had sulfur water with a slight show of oil and gas from perforations in the Glorietta at 5,220-42 ft. Operators squeezed and were preparing to test higher in the hole, and in the same zone. Amerada Petroleum Corp. 2 H.-S. Record, 25-19s-35e, had total depth at 13,012 ft. in unidentified limestone and was coring ahead. Amerada 8 Andrews, 12-20s-36e, was preparing to shoot off the 5-in. casing after failing to develop production around 8,400 ft., plugged back total depth.

In west-central Lea County, 4 miles north of the West Roberts field, Vickers Petroleum Co., Inc. 1 Stanolind-State, 14-16s-32e, was said to have recovered some 3 bbl. of oil a day from the San Andres lime at 4,607-4,824 ft. Operators were drilling deeper.

In Eddy County, Southern Union Production Co. 1 Elliott, 25 miles southwest of Artesia, in 24-18s-25e, was drilling below 9,478 ft. Some reports said the well was out of the Devonian and into the Silurian, but official word was not available. Magnolia Petroleum Co. 1-W State, 16-21s-22e, was drilling ahead below 9,013 ft. in hard sand and lime. Mesa Retailers, Inc. 1 Blindsnake, 2-16s-25e, was drilling below 4,925 ft.

In southwest Chaves County, W. H. Black Drilling Co. 1 Shildneck, 24-16s-20e, new test scheduled to around 6,000 ft., was below 3,000 ft.

SOUTHEAST NEW MEXICO WILDCAT FAILURES

Eddy County: R. W. Fair 1 Anderson, NE NE NE 11-20s-26e, dry, TD 2,200 ft., in limestone, show oil and gas 1,312-26 ft., hole full of water at total depth.

Lea County: Euromex Oil Co. 1 Andrews, NE NE 14-16s-38e, dry, TD 5,730 ft., Yages 3,170 ft., San Andres 5,020 ft., elev. 3,712 ft.

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OKLAHOMA

Prospective Discovery for Stephens County

STEPHENS County has good prospects for a discovery well east of the Velma field at Gulf Oil Corp. and Stanolind Oil & Gas Co. 1 Oklahoma National Unit, SE SE NW 32-1s-4w. Operator recovered 4,850 ft. of oil on a drill-stem test at 6,005-78 ft. Core recovery at 6,202-07 ft. had shaly sand with pinpoint bleeding. Drilling continues below 6,221 ft.

Sinclair Prairie Oil Co. has what appears to be the opening of a second commercial formation in Southeast New Hope pool. Sinclair 1 Hewitt, C NW SW 3-4n-3w, Garvin County, made an estimated 5,000 M.c.f. of gas and considerable distillate from the Chimney Hill section of the Hunton at 7,508-85 ft. Casing has been cemented at 7,582 ft. and total depth is 7,585 ft.

Testing continues at L. C. Tharpe et al 1 Lovell, SE NW SE 29-13n-1e, outpost, west of the Jones pool in Oklahoma County. Crew swabbed 25 to 40 bbl. per hour after drilling plug to test Cleveland sand at 4,885-96 ft.

Sohio Petroleum Co. has started operations at 1 Kirby, NW NW NW 19-1n-3e, Murray County wildcat located east of the Northwest Sulphur pool which was opened by Sohio in 1947.

Skelly Oil Co. continues testing at 1 Bombarger, SW NE SE 12-13n-7e, Okfuskee County. Oil was recovered from the Viola, cut at 4,025 ft., and casing was set at 4,085 ft. for a test of the Wilcox, resulting in recovery of salt water. Hole was plugged back to 4,039 ft. and perforations made at 4,020-37 ft. Crew swabbed 81 bbl. of oil in 12 hours, but after acid treatment the well flowed 162 bbl. in 7 hours through ½-in. choke.

Stephens County appears to be getting a new oil field with deep Pennsylvanian sand production at Tom Palmer 1 Amerada, SE NE NW 31-2n-5w, about 2 miles northwest of the West Doyle field. The well has been testing for some weeks but latest reports indicate production at the rate of 400 bbl. per day. Total depth is 10,142 ft. with casing set at 10,039 ft.

OKLAHOMA SUCCESSFUL WILDCATS

Cleveland County: Mid-Continent 1 Harris, SE SE NW 29-9n-3w, flowed 406 bbl. of 41°-gravity oil per day from Hunton-Bois d'Arc at 8,745-85 ft. through 5/64-in. tubing choke, TD 9,234 ft.

Kay County: Deardorf 1 Merhoff, SE NE SE 12-27n-1e, pumped 27 bbl. of 37°-gravity oil per day from Burbank at 3,562-3,622 ft., TD 4,225 ft.

Oklahoma County: New pay, Witcher—Gulf 1 Joy, C SW NE 30-13n-2w, flowed 421 bbl. of 41.5°-gravity oil per day from sand at 6,23-42 ft., TD 6,277 ft.

Pittsburgh County: Grimes 1 Kleinke, NE SW SW 15-7n-12e, produced 17,000,000 cu. ft. of gas from second Cromwell at 4,245-70 ft., TD 4,270 ft.

OKLAHOMA WILDCAT FAILURES

Beaver County: Stanolind 1 Schneider, SW NE SE 10-6n-20ecm, dry, TD 6,700 ft., no tops reported.

Kiowa County: Lynch 1 Null, NE NE SE

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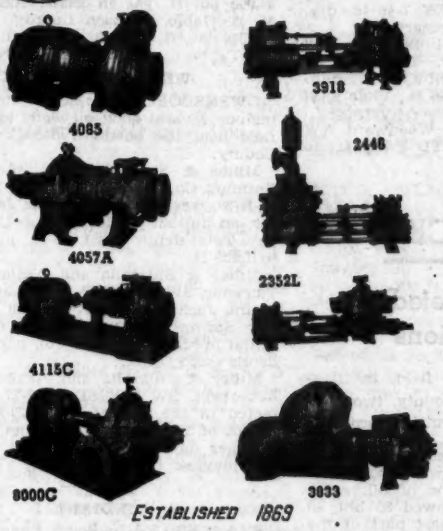

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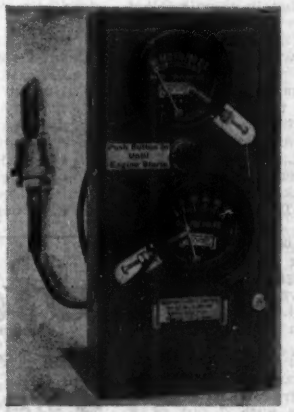

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French Refining Industry Back to Prewar Output

(Continued from page 65)

to meet the current shortage of lubricants in France, the company has decided to construct a new manufacturing unit with a daily output of 2,500 bbl. of lubricating oils. It is hoped that the distillation unit will be operating by 1949 and the lubricating-oil unit by the end of 1950.

A long-range plan of C.F.R. is related to the projected construction of a big-inch crude-oil pipe line from Iranian oil fields to the Mediterranean. *(The Oil and Gas Journal, September 20, 1947, page 158).* Assuming completion of this line, C.F.R. estimates that its share of Middle East crude oil will be 150,000 bbl. daily.

Standard Francaise des Petroles, which had its Port Jerome refinery reduced to a waste of twisted metal by bombing and fire during the last war, restored the refinery in such a manner that it went back on stream in February 1946, but much remains to bring it back to its prewar condition. The company is a subsidiary of Standard Oil Co. (N. J.), Gulf Oil Corp., and Atlantic Refining Co. It is located on the Seine about 23 miles from Le Havre.

As of early this year, Standard Francaise had reconstructed the plant so that crude distillation reached 100 per cent of its 1938 rate. And in 1947 the prewar production of gas oil was exceeded by 200 per cent, and asphalt products by 108 per cent.

The prewar capacity of Standard Francaise was 1,200,000 tons annually, or 24,000 bbl. daily. Current capacity is approximately the same. By October of this year it hoped that the refining capacity will be increased to 40,000 bbl. daily on a purely topping-operation basis. Necessary work includes an increase in the capacity of the Havre pipe-line pumping station, modifications on the two existing pipe stills and the reerection of the lubricating-oil rerun pipe still recovered from Austria.

Other Projects Planned

In order to meet S.F.P.'s share in the modernization program, the erection of a 30,000-bbl. daily atmospheric pipe still is contemplated. Completion is scheduled for 1951. The refining capacity will therefore be increased to 60,000 bbl. daily for manufacture of a full range of products. By 1951 it is also planned to have the Havre crude-oil pipe line looped.

To replace the damaged and removed parts of the lubricating-oil manufacturing equipment and at the same time enable the production of lubricating oils from Middle East crude oils, S.F.P. plans to erect a 1,000-bbl. daily dewaxing plant and a 2,000-bbl. daily deasphalting plant. If materials and dollars are available, it is hoped that these plants can be completed in 1951. In conjunction with this program, additional boilers, utilities, storage tanks, and residential houses also will be built.

Finally, it is expected that a unit will be built to produce a so-called international standard gasoline, instead of the present low-grade 65-70 octane rating product, thus completing the reconstruction and modernization program. Total cost of this program approximates $26,000,000 and will require from 20,000 to 25,000 tons of steel.

(Postwar status of other French refineries and the projected expansion plans will be published in next week's The Oil and Gas Journal.)

A.I.O.C. Production Figures Announced

Iranian crude-oil production of Anglo-Iranian Oil Co., Ltd., totaled 1,730,000 tons, or approximately 418,000 bbl. daily in January, according to B. R. Jackson, New York representative for A.I.O.C.

This compares with a provisional figure of 1,708,000 tons, or approximately 413,000 bbl. daily, for December. Iranian production for January 1947 was 1,640,000 tons, or approximately 396,000 bbl. daily.

The provisional 1947 production figures for Anglo-Iranian's six fields in Iran are: (all in thousands of barrels daily)

Agha Jari, 45,639; Gach Saran, 13,124; Haft Kel, 68,804; Masjid-i-Sulaiman, 21,314; Naft-i-Shah, 1,038; and Naft Safid, 4,942. The Pazanun, a gas field, has been closed down.

The deepest zones tested, to the end of last year, in all Iranian fields and the actual footages are:

Asmari zone in Agha Jari, 5,477 ft.; Eocene zone in Gach Saran, 6,830 ft.; Cretaceous zone in Haft Kel, 5,671 ft.; Cretaceous zone in Masjid-i-Sulaiman, 5,298 ft.; Kalhur zone in Naft-i-Shah, 4,048 ft.; Asmari zone in Naft Safid, 6,157 ft.; and Asmari zone in Pazanun, 7,294 ft.

Doubled Oil Consumption Seen in Turkey in 1948

Turkey's oil consumption is expected to exceed 400,000 tons annually (8,000 bbl. daily) this year, which is double the prewar figure, according to the minister of commerce in Ankara. By 1949, it is expected that the annual consumption will approximate 1,000,000 tons (20,000 bbl. daily).

To handle this ever-increasing consumption, the commerce minister, M. Mahmutedim Gunuzalph, stated that new oil depots would have to be opened throughout Turkey and a new factory built to manufacture oil containers.

Turkey's first successful wildcat was brought in during March. *(The Oil and Gas Journal, March 18, page 79, and March 11, page 63).*

FCC Studies Radio Needs For Offshore Operations

WASHINGTON. — Assignment of radio frequencies for use in offshore geophysical work is under consideration by the Federal Communications Commission, following representations by Oil and Gas Division officials that companies anxious to undertake exploration in Gulf of Mexico waters are being held back by the lack of channels.

FCC officials indicated this week that they are anxious to aid the oil industry, but may find difficulty in fitting it into the radio pattern. However, unless serious engineering problems arise, it is probable some provision will be made for the service, possibly on a temporary basis by permitting the use of channels that have been reserved for the Coast Guard or other services.

LEGAL

U. S. Department of the Interior, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that the lands listed herein are offered through sealed bids on the terms hereinafter specified, to qualified bidders of the highest cash amounts per acre as a bonus for the privilege of leasing the lands under sec. 17 of the Leasing Act of February 25, 1920 (41 Stat. 437; 30 U.S.C. sec. 181), as amended. All bids must be submitted to the Director, Bureau of Land Management, Washington 25, D. C., on or before 1 p.m. of the date set out herein. Each bidder must submit with the bid one-fifth of the amount bid in cash or by certified check on a solvent bank or by money order made payable to the order of the Treasurer of the United States, and file the showing of qualifications to receive a lease required under 43 CFR 192.42 (b) and (c). The envelopes should be plainly marked that they are not to be opened before the date and hour set out herein, and should show the number of parcel and the name of the field. No bids received after the hour fixed herein for receiving bids will be considered. The remainder of the bonus and the annual rental must be paid and an acceptable surety bond in the sum of at least double the amount of rental, but in no case less than $1,000 nor more than $5,000, must be furnished by a successful bidder prior to the issuance of a lease. An acceptable $5,000 surety bond will be required prior to commencing drilling operations on the land. The deposits of the other bidders will be returned upon acceptance of the successful bids. Bidders are warned against violation of section 59, U. S. Criminal Code, approved March 4, 1909, prohibiting unlawful combination or intimidation of bidders. The right is reserved to reject any and all bids. Royalties payable to the United States will be at the rate of 12½ per cent to 25 per cent for oil, and 12½ per cent to 16⅔ per cent for gas, in accordance with Schedule B in the lease form. Annual rental will be at the rate of $1.00 per acre. The lands are in the Lake Bisteneau field, La. M., Louisiana, and are offered in the following parcels, all in T. 16 N., R. 10 W.: Parcel No. 1, Sec. 4, lots 5, 6, 7, 8, 86.34 acres. Parcel No. 2, Sec. 5, lot 1; Sec. 8, lots 1, 2, 3, 4, 5, 6; Sec. 9, lots 8, 9, 10, 231.72 acres. Parcel No. 3, Sec. 22, NW¼SE¼, 40 acres. Total, 360.06 acres. Bids must be submitted on or before 1 p.m., May 6, 1948, and must be submitted on each parcel separately, but no objection will be made to the award of more than one parcel to the same successful bidder. Marion Clawson, Director.

STATISTICS and

WEEKLY WELL COMPLETIONS . . . WEEK ENDED APRIL 17, 1948

	Total of all wells					Cum.		Wildcat completions and discoveries									
													Cumulative total, 1948				
	Comp.	Oil	Gas	Dry	Footage	1948	1947	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
New York	32	16	0	*16	38,124	463	395	0	0	0	0	0	0	0	0	0	0
Pennsylvania	50	22	5	†23	111,017	839	922	0	0	0	0	0	0	0	5	11	16
West Virginia	17	2	9	6	40,570	222	241	0	0	0	2	2	2	0	16	21	39
Ohio	23	10	7	‡6	55,830	362	368	0	0	2	1	3	1	0	6	10	17
Indiana	19	12	2	5	40,052	267	163	2	0	1	2	5	4	0	1	6	11
Kentucky	14	6	4	4	22,848	179	138	0	0	0	0	0	2	0	0	4	6
Illinois	25	12	1	12	65,415	541	533	0	0	0	3	3	10	0	0	92	102
Michigan	12	7	0	5	32,794	187	170	0	0	0	4	4	5	0	5	74	84
Kansas	46	15	6	25	146,726	739	755	0	0	0	7	7	9	0	1	92	102
Neb., Mo., Iowa	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Oklahoma	80	42	7	‡31	239,010	1,071	1,220	3	0	1	7	11	38	3	7	171	219
Texas	220	141	6	73	941,934	3,107	2,448	4	0	3	41	48	87	8	34	560	689
North Central (Dist. 7-B & 9)	67	41	0	26	193,348	923	752	1	0	0	11	12	35	0	6	176	217
West (Dist. 7-C & 8)	57	50	0	7	257,232	§837	575	2	0	0	4	6	12	0	1	62	75
Panhandle (Dist. 10)	15	11	1	3	54,513	174	134	0	0	0	1	1	0	0	1	4	5
Eastern (Dist. 5 & 6)	6	3	0	3	26,190	162	147	0	0	0	3	3	4	0	0	43	47
Gulf Coast (Dist. 2 & 3)	40	22	2	16	241,562	491	470	1	0	1	10	12	23	7	8	124	162
Southwest (Dist. 1 & 4)	35	14	3	18	169,089	520	370	0	0	2	12	14	13	1	18	151	183
Louisiana	67	44	9	14	239,865	544	344	0	0	0	7	7	8	5	1	56	70
Northern	59	40	9	10	157,698	362	165	0	0	0	5	5	0	0	0	28	28
Southern	8	4	0	4	82,167	182	179	0	0	0	2	2	8	5	1	28	42
Arkansas	11	6	0	5	50,587	90	73	0	0	0	4	4	2	0	0	25	27
Mississippi	7	6	0	1	49,045	114	101	0	0	0	1	1	2	0	3	25	30
Southeastern States	0	0	0	0	0	12	15	0	0	0	0	0	0	0	0	11	11
Montana	4	1	0	3	10,473	69	46	0	0	0	0	0	1	0	0	7	8
Wyoming	6	6	0	0	23,488	109	60	0	0	0	0	0	5	0	0	13	18
Colorado-Utah	1	1	0	0	6,613	75	52	0	0	0	0	0	0	0	0	14	14
New Mexico	19	13	1	5	71,349	186	150	0	0	0	2	2	3	1	0	12	16
California	65	56	0	9	195,597	818	577	5	0	0	4	9	11	0	0	73	84
Total United States	718	418	57	243	2,381,137	9,994	8,773	14	0	7	85	106	190	17	79	1,277	1,563
Total previous week	621	337	47	237	2,132,120	9,276	8,236	8	0	7	82	97	176	17	72	1,192	1,457
Total April 19, 1947	537	293	56	188	1,821,295			11	0	2	52	65	186	25	46	1,077	1,334

Service wells included: *16, †22, ‡1. §Revised.

CRUDE PRICES AND REFINERY ACTIVITY

GRAVITY SCHEDULES

Top prices include all gravities above grades designated, and low prices include all gravities below grades designated:

Gravity—	Signal Hill, Calif.	Oklahoma, Kansas	Gulf Coast Tex.*	West Tex.†
18-18.9	$2.17	....	....	....
19-19.9	2.19	....	....	....
20-20.9	2.21	$2.25	....	$2.12
21-21.9	2.23	2.27	....	2.14
22-22.9	2.27	2.29	....	2.16
23-23.9	2.30	2.31	....	2.18
24-24.9	2.34	2.33	$2.56	2.20
25-25.9	2.38	2.35	2.58	2.22
26-26.9	2.41	2.37	2.60	2.24
27-27.9	2.45	2.39	2.62	2.26
28-28.9	2.49	2.41	2.64	2.28
29-29.9	2.52	2.43	2.66	2.30
30-30.9	2.56	2.45	2.68	2.32
31-31.9	2.59	2.47	2.70	2.34
32-32.9	2.62	2.49	2.72	2.36
33-33.9	....	2.51	2.74	2.38
34-34.9	....	2.53	2.76	2.40
35-35.9	....	2.55	2.78	2.42
36-36.9	....	2.57	2.80	2.44
37-37.9	....	2.59	2.82	2.46
38-38.9	....	2.61	2.84	2.48
39-39.9	....	2.63	2.86	2.50
40 and above	....	2.65	2.88	2.52

*For crude from Daboval, El Campo, and Sand Point. †Includes Lea County, New Mexico.

A.P.I. REFINERY REPORT, WEEK ENDED APRIL 10

(Thousands of barrels)

District—	Crude runs, daily avg.	Production: Gasoline†	Kerosine	Gas & dist. oil	Residual	Stocks at refineries, bulk terminals, in transit and in pipe lines: Gasoline*	Kerosine	Gas & dist. oil	Residual
East Coast	861	2,175	378	1,242	1,606	23,587	4,482	8,552	8,082
Appalachian:									
District 1	96	265	60	69	75	2,122	185	348	293
District 2	68	228	28	65	100	1,024	129	159	92
Ind., Ill., Ky.	894	2,853	434	1,003	1,070	21,775	1,877	3,876	3,012
Okla., Kans., Mo.	445	1,475	213	560	471	10,516	585	1,649	1,392
Inland Texas	245	1,021	118	148	495	4,207	398	302	884
Texas Gulf Coast	1,400	4,016	725	2,272	1,979	19,243	1,052	4,482	5,355
La. Gulf Coast	433	1,268	348	746	593	5,683	995	1,936	1,342
N. La. and Ark.	82	226	76	116	131	2,049	446	487	131
Rocky Mountain:									
New Mexico	12	41	4	11	27	92	25	17	30
Other Rocky Mtn.	133	421	28	156	264	3,167	125	675	733
California	899	2,576	60	1,031	2,357	18,124	1,139	10,638	27,882
April 10, 1948	5,568	16,569	2,472	7,419	9,168	111,589	11,438	33,121	49,228
April 3, 1948	5,475	‡15,735	2,484	7,586	9,084	‡113,261	10,930	32,180	47,959
April 12, 1947	4,637	14,130	2,038	5,397	8,185	104,521	9,492	30,627	42,753

*Finished and unfinished. †At refineries including natural blended. ‡Revised.

Bureau of Mines crude-oil stocks 222,659,000 bbl. as of April 10—down 356,000 bbl. One year ago 231,546,000 bbl.

FLAT CRUDE PRICES

Representative posted schedules per bbl.		Pecos County, Texas (Yates)	2.35
East Texas	$2.65	Bradford, Pennsylvania	5.00
Kettleman Hills, California*	2.14	Eastern Ill. and Western Ind.†	2.77
Beauregard Parish	2.60	Tomball, Texas Gulf Coast	2.83
Illinois Basin	2.77	*37°-37.9°. †35° and above.	

TRENDS

DAILY AVERAGE PRODUCTION FOR WEEK

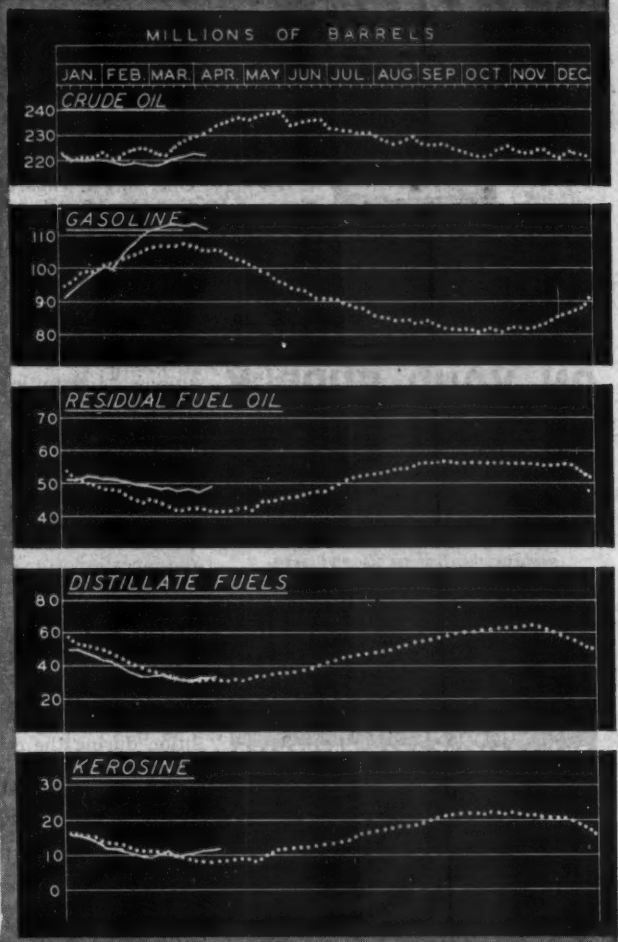
	April 17 crude oil	B. of M. April demand	April 10 crude oil
Alabama	1,100	1,500	1,350
Arkansas	88,650	83,000	87,700
California	941,800	930,000	943,100
Colorado	43,940	48,000	45,200
Eastern	67,350	64,900	67,950
Florida	825	1,000	825
Illinois	170,700	178,000	174,600
Indiana	17,800	16,000	19,200
Kansas	297,850	304,000	284,300
Kentucky	24,000	26,000	24,600
Louisiana	481,050	475,000	479,700
North Louisiana	126,650	.....	125,300
South Louisiana	354,400	.....	354,400
Michigan	46,800	46,000	45,100
Mississippi	117,235	116,000	111,185
Montana	23,080	24,000	22,750
Nebraska	450	600	450
New Mexico	127,600	129,000	127,600
Oklahoma	404,300	415,000	402,200
Texas	2,419,000	2,450,000	2,419,000
Dist. 1 (Southwest)	25,800	.....	25,800
Dist. 2 (Southwest)	172,350	.....	172,350
Dist. 4 (Southwest)	253,400	.....	253,400
Dist. 3 (Gulf Coast)	493,300	.....	493,300
Dist. 5 (Eastern)	46,125	.....	46,125
Dist. 6 (Eastern)	121,400	.....	121,400
East Texas Field	316,500	.....	316,500
Dist. 7-C (West)	44,400	.....	44,400
Dist. 8 (West)	679,325	.....	679,325
Dist. 7-B (W. Central)	44,550	.....	44,550
Dist. 9 (N. Central)	137,600	.....	137,600
Dist. 10 (Panhandle)	84,250	.....	84,250
Wyoming	140,830	142,000	143,450
Total United States	*5,414,360	5,450,000	5,400,260
Change from prev. wk., up	14,100		

Total production January 1-April 17..... †584,485,965 bbl.
Same period last year (crude plus cond.).. 514,627,700 bbl.

*Not incl. 54,930 bbl. condensate. †Incl. 5,583,485 bbl. condensate.

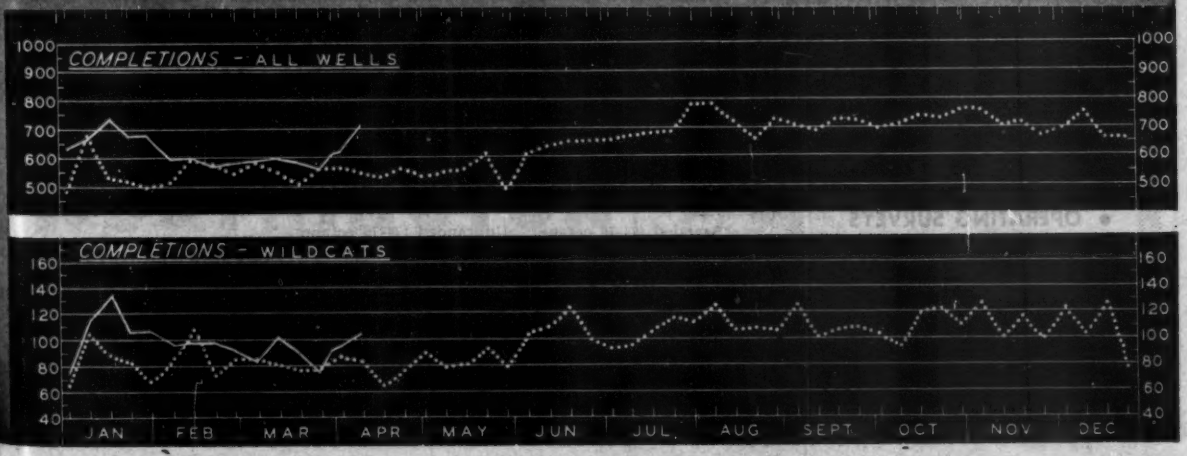
STOCKS IN UNITED STATES

---- 1947 ——— 1948



---- 1947 **DAILY OPERATIONS** ——— 1948

---- 1947 **WEEKLY COMPLETIONS** ——— 1948



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Use it on every threaded connection and you'll never be troubled with leaking connections. Over a million pounds used by the Industry in nine years.

Manufactured in Houston, Texas, by
RECTOR WELL EQUIPMENT CO., Inc.
Gen'l. Offices: Fort Worth, Texas

RECTORSEAL
THE POSITIVE LEAK PREVENTER

TRECo
REFINERY
CONSTRUCTION

If you are planning an expansion or an entirely new refinery or chemical plant, a call from you will be appreciated. We can handle the complete project from drafting boards to operating profits.

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- CONSTRUCTION
- OPERATING SURVEYS

THE REFINERY ENGINEERING CO.
Tulsa Chicago

MARKETS

IN New York Harbor last week spot prices for open market materials were reported to have strengthened considerably. Offerings of home heating oils and industrial oils were said to be becoming increasing scarce. One buyer reported that he could find No. 2 oil no lower than 10.5 cents.

One large independent in Baltimore rescinded his offer of the 0.7 cent per gallon discount on kerosine and home heating oil in view of the disinclination of East Coast majors, with exception of Shell, to follow Esso's summer discounting policy.

Prices generally remained unchanged along the Atlantic Seaboard.

Gulf Market Stronger

The market for motor fuel was considerably stronger in Gulf Coast trading last week. Regular grade on the open spot market was reported moving at 12 to 12½ cents, and material was increasingly difficult to find. Premium gasoline was ranging its usual ¾ cent higher.

Conforming to seasonal tendencies, No. 2 and kerosine continued somewhat weaker compared to their position during the colder weather several weeks back. Tank-car prices of No. 2 were lower at around 10 cents, and some of this product was going to storage. The barge market in No. 2 was said to be still strong, however.

The possibility of another increase in crude-oil prices continued to occupy the attention of marketers. One well-informed observer of the crude-oil situation said demand was placing an increasingly greater pressure on posted prices. Reports of premiums of 25 and 30 cents per barrel, and 50 cents in the case of one Oklahoma refiner, were heard.

In the Mid-Continent area a definite easing in tank-car availability was reported. One marketer said that while a week ago the big difficulty was one of getting tank cars, now the chief problem is that of obtaining products, particularly gasoline. Refiners, he said, were now quoting in sellers' cars as well as buyers' cars.

Demand for gasoline continued strong but few offerings were reported except at "high levels." However one buyer reported several movements at 11½ to 11¾ cents.

No. 2 was reported "easing off" but there was no noticeable decline in the price level and according to one source little drop in the price could be expected. Refiners who have cracking facilities would make No. 2 into gasoline and only smaller refineries would carry any amount of this product. One shipment of several cars was reported at 10 cents, however some shipments, unconfirmed, were said to have gone below this.

Inquiries for No. 2

According to one marketer No. 2 would not be cheap in the near future and that those awaiting a further drop in price for this product may be disappointed. Inquiries for No. 2 were said to be frequent.

Price of crude scale wax 130-132 A.S.T.M. was again reduced by a leading marketer in the Mid-Continent area from 8 to 7½ cents per pound. Less than 2 months ago this same supplier was quoting 9¼ cents per pound for crude wax.

Kerosine remained in fair demand and according to one observer this was due to wide use by agricultural consumers. Demand from this quarter continued strong. From Minnesota urgent inquiries continued for gasoline in preparation for the peak of the farming season. One shipment for this area was reported at 12½ cents, buyer's cars.

Representative Quotations

Representative spot-market quotations of leading suppliers as of April 19, 1948. Figures are f.o.b. plant for tank-car shipment in cents per gallon, except for residual fuel oil which shows the price per barrel and wax, in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor	Texas Gulf Coast
Regular gasoline, 73-75 octane	10½-11½	11.6-12* 10.5-12.2†	10.9-12½
Premium gasoline, 78-80 octane	11¾-12½	10.6-13.4	12.9-13¼
42-44 w.w. kerosine	9½-10½	10.2-12.2	10¼-11
No. 2 straw fuel oil	9½-10	9.3-11.1	9.05-10¼
No. 6 residual	$2.50-2.75	$3.03-3.90	$2.56-2.80

*Branded (74-76 octane); †Unbranded (74-76 octane).

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	8½	8	8¼
Grade 18-55	10.2	9.6	9.9

LUBRICATING OILS

South Texas	
200 vis., No. 2-3 neutral	13-14.5
750 vis., No. 3-4 neutral	15-17.25
2,000 No. 5-6 neutral	17-18½

LUBRICATING OILS

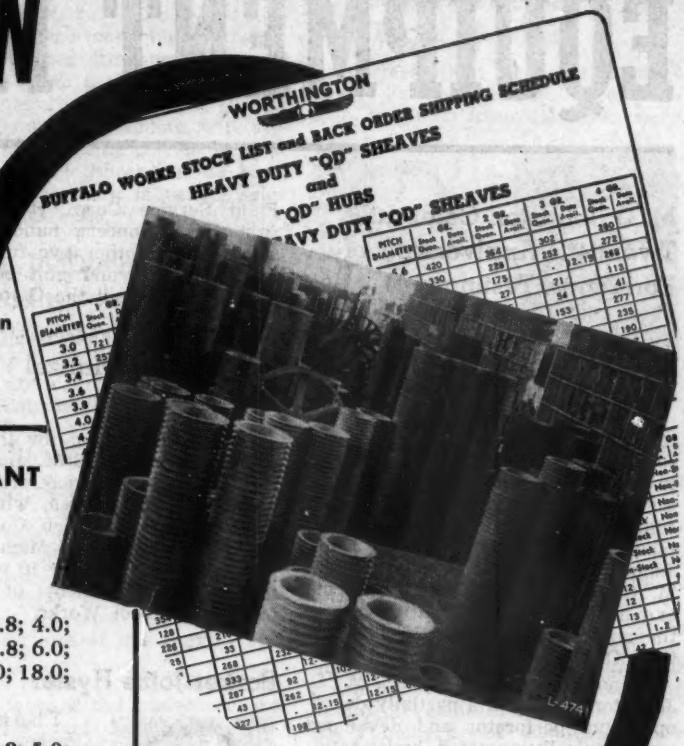
Mid-Continent	
150-160 vis., D bright stock, 0-10 pp.	30-33
200 vis. No. 3 neutral, 0-10 pp.	20-21
Western Pennsylvania	
145-155 vis. 10 p.t. bright stock	47
180 vis. p.t. neutral	45

CRUDE-SCALE WAX

Mid-Continent	
130-132 A.S.T.M. melting point	7½

Available NOW from Stock

Immediate delivery from your local Worthington distributor . . . or five days from factory.



Part of the complete stock of Worthington QD sheaves in all sizes. Enormous stock of Worthington-Goodyear V-Belts is also available—teammates for *balanced drive performance . . . more worth with Worthington.*

FIND THE SHEAVES YOU WANT from this complete line of *available* sheaves

A Section—1 to 4 Grooves
Pitch Diameters 3.0; 3.2; 3.4; 3.6; 3.8; 4.0; 4.2; 4.4; 4.6; 4.8; 5.0; 5.2; 5.4; 5.6; 5.8; 6.0; 6.2; 6.4; 7.0; 8.2; 9.0; 10.6; 12.0; 15.0; 18.0; 22.0

B Section—1 to 4 Grooves
Pitch Diameters 4.0; 4.2; 4.4; 4.6; 4.8; 5.0; 5.2

B Section—1 to 10 Grooves
Pitch Diameters 5.4; 5.6; 5.8; 6.0; 6.2; 6.4; 6.6; 6.8; 7.0; 7.4; 8.6; 9.4; 11.0; 12.4; 13.6; 15.4; 16.0; 18.4; 20.0

B Section—2 to 10 Grooves
Pitch Diameters 25.0; 30.0; 38.0

C Section—1 to 6 Grooves
Pitch Diameters 7.0; 7.5

C Section—1 to 8 Grooves
Pitch Diameters 8.0; 8.5; 18.0

C Section—1 to 12 Grooves
Pitch Diameters 9.0; 9.2; 9.4; 9.6; 9.8; 10.0; 10.2; 10.6; 11.0; 12.0; 13.0; 14.0; 16.0; 20.0; 24.0

C Section—3 to 12 Grooves
Pitch Diameters 30.0; 36.0; 44.0; 50.0

D Section—3 to 12 Grooves
Pitch Diameters 12.0; 13.0; 13.5; 14.0; 14.5; 15.0; 15.5; 16.0; 18.0; 20.0; 22.0; 27.0; 33.0; 40.0

D Section—5 to 12 Grooves
Pitch Diameters 48.0; 58.0

For quick delivery of the sizes you need, call your local Worthington Multi-V-Drive distributor (listed in Thomas Register).

WORTHINGTON

Worthington Pump and Machinery Corporation, *Merchandising Division,* Harrison, N. J. *36 district offices throughout the United States.*

WORTHINGTON QD Sheaves

The *original* tapered cone-grip sheaves that are *easy to get on, easy to get off, yet always tight on the shaft.*

791 Stock Sheaves—18 Stock Hubs give you a total of 75,000 V-drive combinations ranging from ½ hp to 600 hp in A, B, C and D Sections.

If you have not already received your copy of the Worthington QD Sheave Bulletin, mail this coupon.
Please send me free copy of WORTHINGTON QD Bulletin V-1400-3837J.

Name .....

Company .....

Address .....

88-37

EQUIPMENT MEN ... in the News

M. O. Johnston Celebrates Twentieth Anniversary of Formation Testing

M. O. Johnston, pioneer oil man, inventor and manufacturer, is celebrating the twentieth anniversary of the Johnston formation tester.

A family project, the Johnston tester was designed and built by the seven Johnston boys in the middle twenties while contracting and drilling wells in Arkansas. The first commercial run of the tester was made in May 1928. While J. L. Johnston introduced the tool in Texas, M. O. Johnston came to California and made the first formation test in the state's history in July 1930 for Ohio Oil Co.

In addition to the tester, M. O. Johnston has taken a partially developed gun perforator and developed a mechanically operated, hydrostatically fired tool known as the Johnston "Shoot-N-Test" gun perforator. This tool can be used either for perforating alone, or when attached to the tester, as a unit for combined perforating and testing operations.

Johnston has a unique oil background. His father, R. C., an old-time Texas water-well driller, helped drill the famous Crazy Well at Mineral Wells, Tex., and moved to Beaumont when Spindle Top field was discovered. He raised seven sons, all of whom spent their entire lives in the industry.

M. O. Johnston is president of M. O. Johnston Oil Field Service Co., Los Angeles, and M. O. Johnston Oil Field Service Corp., Los Angeles, and controlling head of the Johnston Oil Field Service Corp., Houston. The first-named concern handles export sales and the other two furnish formation testing and gun perforating service throughout the United States.

Roosa New Manzel Vice President

Herbert H. Roosa, for the past 2 years sales manager of Manzel, Inc., has been elected vice president in charge of sales. Roosa, who studied engineering at Antioch College and later at University of Michigan, was formerly associated for 10 years with the sales department of Niagara Machine & Tool Works.

Parker Joins Hyster

Thomas T. Parker, pressed metal manufacturing engineer, has assumed his new post in that capacity at the Portland plant of Hyster Co., manufacturers of lift and straddle trucks and tractor-mounted construction equipment, according to an announcement by Eugene Caldwell, vice president and general manager.

Parker was formerly assistant to the superintendent at By-Products Steel Corp., Coatesville, Pa., a subsidiary of Lukens Steel Co. He has a record of 19 years' experience in pressed-metal manufacturing.

The Johnston Brothers: E. L., M. O., R. C., J. L., and E. C. (Blaine and J. T. have died). All seven of the boys were instrumental in developing the Johnston formation tester

OCT Names Two for South American Sales

Oil Center Tool Co., Houston, has made arrangements with two experienced oil-field operators to represent the firm in Venezuela, Colombia, and Peru. They are Elmer D. Hall and J. E. (Jimmy) Berry.

E. D. HALL

J. E. BERRY

Hall, who will be stationed at Puerta la Cruz, Venezuela, was formerly employed with Superior Oil Co. as drilling superintendent, in California and Louisiana, and for some time has been connected with Weatherford Spring Co., manufacturers of oil-well cementing equipment.

Berry will be sales representative in Maracaibo. He has been connected with the oil industry since 1933, having worked in Texas and Louisiana and for the past 10 years in western Venezuela as driller, tool pusher, and drilling superintendent for Shell Oil Co., Inc.

Collins Elected to Board Of National Supply

C. I. COLLINS

Stockholders of The National Supply Co. have elected Carl I. Collins a director of the company for a 3-year term. He succeeds T. H. McGraw, Jr., who has retired from the board. Collins is president of Superior Steel Corp., Pittsburgh, and is also a director of American Iron & Steel Institute and of Commonwealth Trust Co. of Pittsburgh.

Henry Chalfant, Edward H. Green, and William B. McFall were reelected as directors for 3-year terms.

Air Reduction Announces Changes

The former apparatus sales department and the former arc-welding sales department are merged into one department to be known as the equipment sales department, it was recently announced by H. F. Henriques, general sales manager, Air Reduction Sales Co., New York. Dale D. Spoor becomes manager of the equipment sales department, Ira B. Yates becomes manager of arc-welding and supplies sales, and J. F. Carroll becomes manager of apparatus sales.

Weaver Joins Houston Firm

Earl M. Weaver has joined the firm of Herb J. Hawthorne, Inc., manufacturer of replaceable-blade geophysical drill bits. Weaver was formerly chief engineer of Gray Tool Co., Houston.

Allis-Chalmers Advances Two

M. L. Noel, vice president and general sales manager of the Allis-Chalmers Tractor Division, has announced the appointment of Richard M. Stone as industrial sales manager. Stone will succeed William J. Faulkner who has resigned to become vice president and part owner of Frantz Tractor Co., Allis-Chalmers' New York dealer.

Stone joined Allis-Chalmers in 1928 and was soon made repair parts manager at Fargo, N. D. A year later he returned to the Milwaukee office as supervisor of repair parts for the tractor division. In 1935 he was promoted to industrial sales manager of the Peoria branch, and in 1943 was appointed assistant manager of the tractor division's export department.

Noel also has announced the appointment of E. G. Kullmann as assistant general sales manager. On his new assignment Kullmann will undertake for the entire tractor division duties similar to those he has been handling as assistant industrial sales manager since 1939.

Clausel, McDonald In Canada

C. L. Clausel and C. B. McDonald of A-1 Bit & Tool Co., of Houston, left this week for a 3-week trip to Alberta, Canada.

J. H. Williams & Co. Holds Sales Conference

J. H. Williams & Co., Buffalo, manufacturer of drop-forgings and drop-forged tools, recently completed an intensive 3-day sales conference attended by its sales representatives from all sections of this country and Canada.

A. D. Armitage, president of the company, opened the conference and the sessions were directed by E. J. Wilcox, vice president, and J. B. Perkins, sales manager. Sales and advertising plans were discussed and new products introduced. Principal among the new developments was a complete line of impact sockets designed specifically to withstand the impact of today's powerful pneumatic or electric impact wrenches and power nut runners which have become so important on industrial production lines.

A line of soft-faced hammers with replaceable and interchangeable tips in varying degrees of hardness was unveiled for the first time. A complete new line of detachable socket sets and standard wrench lines were also presented.

Sales representatives at J. H. Williams & Co. conference:
Front row: C. W. Stuff; G. W. Klier, Jr.; R. W. Richards; G. W. Klier, Sr.; A. D. Armitage; J. C. Sanford; H. M. Robins; J. Stickles; M. Durston; E. Donaldson; C. F. Murphy
Center row: R. F. Ericson, J. W. Wells, M. I. Hudson, W. F. Russell, G. W. Caruso, F. D. Townsend, J. B. Perkins, W. J. Johnson, A. C. Pontius, R. I. Barnstead, W. C. Harck
Back row: C. F. Miller, W. C. Kress, E. J. Wilcox, F. B. Roberts, J. E. Good, C. F. Coates, G. B. Allen, J. J. McCann, M. W. Applegate, J. Flaherty, H. Wisbauer, A. E. Schierbaum, B. Williams, J. S. Sanford, T. A. Cooney, V. E. Nagle, H. C. Hollwedel

Fairbanks-Morse Elect Two Board Members

At a meeting of the board of directors of Fairbanks, Morse & Co., Chicago, two men from the ranks were

L. W. STOLTE

F. J. HEASLIP

elected directors of the company to replace A. E. Ashcraft and F. C. Dierks.

The two new directors are L. W. Stolte, who has been secretary of the company for the past year, and Frederick J. Heaslip, who has for a number of years been director of purchases.

Both of the new directors came up through the ranks, Stolte joining the organization in 1928 as a bookkeeper in the Cleveland branch and successively being credit manager of the Cleveland branch and more recently transferred to the Chicago office where he became secretary; and Heaslip joining the company 21 years ago as a buyer in the purchasing department and advanced from time to time to assistant purchasing agent and more recently director of purchases.

Bethlehem Moves West Texas Office

Bethlehem Supply Co. announces the moving of its West Texas and New Mexico district office from the Odessa store to the Midland Tower Building, Room 927, at Midland.

W. A. LaRew, formerly assistant district manager at Odessa, has been promoted to district manager at Midland. "Babe" LaRew has been in engineering-construction work for 21 years and has been affiliated with Bethlehem since January 1945.

R. E. Throckmorton, Jr., formerly field representative at Midland, has been promoted to local representative and will headquarter in the new office at Midland.

W. A. Langbein, formerly store manager and field representative at Odessa, has been promoted to assistant manager of the West Texas and New Mexico district and will headquarter at the Odessa store. K. M. Cook, formerly store manager and field representative at Hobb, N. M., has been transferred in the same capacity to Odessa to replace W. A. Langbein.

Thomas Ray, Jr., formerly chief clerk in the Central Oklahoma district

(Continued on page 169)

Classified Advertising

The Market Place for the Oil Industry

UNDISPLAYED

All ads, 10 cents a word. Minimum charge, $2.00 per insertion.
Centered Line, any ad, 75 cents.
Box Numbers count 9 words when replies are to be sent to our Tulsa Office. Replies forwarded without charge.

DISPLAYED, PER INCH

$10.00 per column inch per insertion. One-point border and 12-point capitals are allowed. Larger type sizes not accepted.

All classified advertising payable in advance.
10% Discount if 3 insertions are ordered at one time.
COPY DEADLINE, 9:00 a.m. Monday prior to each week's issue.

THE OIL AND GAS JOURNAL
P. O. Box 1260, TULSA, OKLAHOMA

EQUIPMENT FOR SALE

FOR CABLE TOOLS
DEGEN PIPE AND SUPPLY CO.
Box 107, Red Fork Station, Tulsa, Oklahoma

FOR SALE: Near Duncan, Oklahoma, 1—4 x 6 Wheatley Power Pump, 750# working pressure, on steel base, less engine, Worm Drive, price $200. Cities Service Oil, Patridge, Bartlesville, Okla.

FOR SALE: At Seminole, Oklahoma, 1—50 HP 250 RPM, Cooper Bessemer G-AO Horizontal Single Cylinder Gas Engine used for centrifugal pump and generator drive. $650. Cities Service Oil, Patridge, Bartlesville, Okla.

23 STEEL STORAGE TANKS IN STOCK

3—Like New 74,000 Bbl. Cap. Vert. Riveted.
1—New 10,000 Bbl. Cap. Vert. Bolted Type.
1—New 5,000 Bbl. Cap. Vert. Bolted Type.
6—New 20,000 Gal. Cap. 10' x 34' Horiz. Welded.
6—New 12,000 Gal. Cap. 10' x 20'6" Horiz. Welded.
6—New 10,000 Gal. Cap. 10' x 17'2" Horiz. Welded.

DARIEN CORP.
60 E. 42nd. St., N. Y. 17, N. Y.

EQUIPMENT FOR SALE

37 SULLIVAN, Reconditioned on 42-V8, also 44 Failing good condition. P. O. Box 1832, Casper, Wyoming.

FOR SALE: Tool to control flow. Won't allow fluid to be produced below face of pay, but allows fluid to be produced from bottom of hole if wanted. Works on pumping or flowing wells, can be pumped through from the top. Two patents issued, one pending. Patents and tool for sale with no strings attached. W. T. Hobbs, 511 North Main, Fort Worth 6, Texas.

FOR SALE: Model "N" Sullivan Core Drill Unit on 6 x 6 GMC truck. 1,000 feet "N" rod. Two 20 foot and one 10 foot core barrel. One 6 inch and 4 inch bailer. 1940 D-30 International truck with water tank and pump. Tools and subs. Paul E. Hardy, Rt. #2, Box 42-A, Bob Street, Santa Fe, New Mexico. Phone 3166W.

PARTS FOR ARMY TRUCKS

New and Used

Largest stock in America, 6x8, 6x4, 4x4, 4x2. All items guaranteed. Largest auto wrecking house in the west with most complete stock of new and reconditioned parts for all cars and trucks. New jeep power units complete with radiators and stub shafts. Fast service.

PIONEER AUTO WRECKING CO.
732 W. 13th Ave. Denver 17, Colo.

FOR SALE STEEL STORAGE TANK

1—5,500 Barrel
5—8,000 Gallon R.R. Tank Car Tanks Coiled and Non-Coiled
4—10,000 Gallon R.R. Tank Car Tanks Coiled and Non-Coiled
1—12,000 Gallon R. R. Tank Car Tank Coiled
4—9,800 Gallon Horizontal Steel Storage Tanks, 8' Diameter x 28' long.

Available at Once!

IRON & STEEL PRODUCTS, INC.
43 years' experience
13412 S. Brainard Ave., Chicago 33, Ill.
"ANYTHING containing IRON or STEEL"

EQUIPMENT FOR SALE

1—MODEL 10D Jensen Pumping Unit complete with reconditioned Hercules Motor. Excellent Condition. H. W. Beck, Phone #89, Box 403, Grayville, Ill.

45 ST Star Spudder, without tools and line, with 120 hp. Hercules engine. Machine in excellent shape. Travco Equipment Co., 110 Midco Bldg., Tulsa. 5-2251.

RECONDITIONED drilling equipment for deep or shallow wells. Spudders, beams, light rotaries, core drills. Tools, casing, cable. Good used equipment at money-saving prices. Pressey & Son, Pueblo, Colo.

3,000 Ft. 5½" 14# Seamless O.D., 500 Ft. 10¾" 42# Seamless O.D., 7" 20# Seamless O.D., 7" 17# Seamless O.D., 8" 24# Drive Pipe Seamless I.D., 8" 32# Drive Pipe Seamless I.D. Bill Gipson, 3208 E. Easton, Tulsa, 3, Okla.

FOR SALE

12—230 H.P. Type 10 Bessemer New 17" Power Cylinders complete ready to run with 16" to 18" Compressors. 1—230 H.P. Clark Horizontal with Compressors. Located Salem, Illinois.

ENGLE PETROLEUM, Incorporated
Box 655, Evansville, Indiana

PUMPS

Centrifugal and Reciprocating Chrysler Industrial Engines. Write for list and prices.

H. A. McCARTHY
310 Thompson Bldg., Tulsa, Oklahoma
Phone 5-3196

RECONDITIONED ORIFICE METERS FOR SALE

Westcott type A & A Improved	$25.00
Westcott type S	$50.00
Westcott type M	$65.00
Westinghouse & Foxboro	$50.00

Differential range 20", 50" and 100".
Pressure range 50#, 100#, 250# & 500#
Mercury not included in above prices.

UNION GAS SYSTEM, INC.
P.O. Box 463 Independence, Kansas

FOR SALE

17—10,000 barrel new closed A.P.I. bolted type steel tanks, 7 to 10 gauge, 54' 11¾" in diameter by 24'2" high, all complete, now ready for immediate loading.

Approx. 20,000 ft. of 6" O.D. used electric welded steel pipe, approx. ⅛" wall, in approx. 24' lengths, plain end, a No. 1 grade. Approx. 2,000 ft. of 8" O.D. ditto. All the above is located in western California.

A. Greenspon Pipe Co., Inc.
3615 Olive Street
St. Louis 8, Missouri

LIQUIDATING MODERN REFINERY

Houston, Texas

PUMPS—Hot Oil and General Service, Desirable Sizes. **HEAT EXCHANGERS**—Enclosed shell and tube type, Steel and Admiralty Tubes, Floating Head Type, etc.
TOWERS—Varying in sizes from 24" to 7' diameter x 18' to 60'. Most are ½" thick shells. All welded, Bubble Caps and Trays, with Manways each Tray.

CRACKING AND TOPPING FURNACES, VAPORIZERS, RECEIVERS, ABSORBERS and other equipment serving a modern refinery.

STEEL STORAGE TANKS

3—10' x 27'3", Vertical	42,000 gal.	1—7'6" x 29'6", Horizontal	9,700 gal
12—10' x 20', Vertical	21,000 gal.	1—10' x 10', Vertical	6,000 gal.
5—7'6" x 32'10", Horizontal	10,850 gal.	1—8' x 12', Vertical	4,500 gal.
1—12 x 12', Vertical	10,000 gal.	1—9' x 28'8", Vertical	14,000 gal.

Write or phone for complete listing

BROWN-STRAUSS CORPORATION
P. O. Box 78 Phone L.D. 168 Kansas City, 10, Mo.

TANKS

1,065 Gallon Galvanized 12 Gauge 48" x 148"	$104.00
525 Gallon 12 gauge—42" x 86"	55.00
275 Gallon Basement Round, with Leg Lugs, 29¼" x 92", 12 gauge	37.50
275 Gallon Basement Oval, with leg lugs, 14 gauge, 26 x 46 x 80 in.	42.50
300 Gallon Septic Tanks, 14 gauge	48.00
500 Gallon Septic Tanks, 14 gauge	58.15
300 Gallon Farm Tanks	42.50

Immediate Delivery. U/L on All Sizes. All Shipment on S/D/B of L.
Mention Bank.

DIRECT SALES
821 West 17th St.—Kansas City, Missouri
Phone Ba. 2837